110237

APPENDIX 6
GEOLOGY AND GROUND WATER DESCRIPTIONS
FORM 6R AND 7R

From:
Commonwealth of Pennsylvania
Department of Environmental Resources
Bureau of Waste Management

Date Prepared/Revised

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WASTE MANAGEMENT

I.D. Number

FORM 6R
GEOLOGIC INFORMATION

General References: Sections 288.121, 288.122, 289.121, 289.122, 295.114

Facility Name: ______________________________

County: ______________________________

Municipality: ______________________________

Instructions: All plans, cross-sections, and maps submitted to complement the descriptions required *from the applicant in this portion of the application shall be on a scale of one inch equals no more* than 200 feet on the base map so that all maps and cross-sections may be readily compared. The application shall contain a comprehensive narrative-type description of the geology in the proposed permit area and adjacent areas. Information (excepting maps and cross-sections) must be submitted on attached 8 1/2 x 11 inch sheets.

1. Stratigraphy/Lithology

The narrative description should include information with regard to glacial, colluvial, alluvial, and lacustrine deposition including the range in thickness. Rock unit groups and formations should also be identified and development of any saprolite should be noted. The narrative description must be correlated with and be complementary to the base map, one copy of which must include geologic details. SEE APPENDIX 6A

a. Correlation of all strata (a minimum of two cross-sections or fence diagrams) including lithology, stratigraphy, existing ground surface, and all aquifers to be encountered or affected is required. Horizontal scale should be the same as the base map. SEE APPENDIX 6B

b. Geologic logs of all boreholes and core borings should use the format on page 3 of this form. Log description should include the actual surveyed surface elevation, bottom elevation, elevation of static ground water level, the date measured, and method of water level measurement. The lithologic description and thickness of each strata encountered must be detailed. The comments column should address moisture conditions, fractures, etc. SEE APPENDIX 6C

A minimum of three boreholes is required, at least one of which shall be a core boring.

c. For any boring or coring not cased and capped or not to be used for ground water monitoring, plans for grouting or otherwise sealing the borehole must be submitted for Department approval. SEE TEXT OF "Site Evaluation Report"

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Sheet ____ of ____

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2. Structure

Applicants must submit a 1 inch equals 200 feet geologic map with an adequate number of measurements to fully characterize the structural features of the proposed permit area. The locations of all bedding planes, jointing, cleavage, and fault measurements must be shown on the map. All data should be based upon field measurements. The narrative must discuss the following:

a. Geologic structure within the proposed permit area in relation to regional geological structure.

b. Folding, fractures, joints, faults, bedding planes, and their control on the movement of ground water (spacing, width, filling, openness, etc.).

c. Local structure in detail (using cross-sections to enhance the description):

SEE APPENDIX 5D & 6A

d. Folding as it applies to the site; using cross-sections (above) which should include a profile of the fold axis: or axes (if any):

SEE APPENDIX 6A

Strike of the fold axis or axes: SEE APPENDIX 6A AND 5D

Plunge of axis or axes: SEE APPENDIX 6A AND 5D

Location of the proposed site in relation to the local structure: SEE APPENDIX 6A

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Sheet ____ of ____

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I.D. Number

Borehole Number: ____________________

Surface Elevation (Ft/MSL): ____________________ (ft)

Borehole Diameter: ____ inches, From ____ To ____

____ inches, From ____ To ____

Total Depth: ____________________ (ft)

Depth to Static Ground Water Level (SWL): ________ (ft)

Date SWL Measured: ____________________ (mm/dd/yy)

Drilling Method: ____________________

Date Drilled: ____________________ (mm/dd/yy)

Drilled By: ____________________

Drillers License Number: ____________________

Logged By: ____________________

County: ____________________

Township or Municipality: ____________________

Depth (Ft)	Lithologic Description	Plot	Ground Water* Observations	Samples No.	Samples Rec** / Att	Comments	Well/Piezometer Construction	Depth (Ft)

* ▽ Encountered Ground Water ▼ Composite Static Water Level ** Recovered/Attempted

Use additional sheets with this format as necessary

AR312895

Date Prepared/Revised

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WASTE MANAGEMENT

I.D. Number

FORM 7R
HYDROGEOLOGIC INFORMATION

This form must be fully and accurately completed. All required information must be typed or legibly printed in the spaces provided herein. Replacement/substitution of or attachment to this form is prohibited. Improperly completed forms may be rejected by the Department, may be considered to be violations of the Department's Rules and Regulations, and may result in assessment of fines and penalties.

General References: Sections 288.121, 288.122, 288.125, 289.121, 289.122, 289.125, 291.105 and 291.106

Facility Name: ______________________

County: ______________________

Municipality: ______________________

Instructions: A narrative description of the general characteristics of the hydrogeology at the proposed site and contiguous properties (down to and including the lowest aquifer that may be affected by the facility) must be submitted, as well as the characteristics listed below. Information, except maps, may be provided on attached 8 1/2 x 11 inch sheets as needed.
SEE APPENDIX 5D AND 6D.

1. Hydrologic characterization of each aquifer will be based upon multiple well aquifer tests when possible; the following determinations must be made and calculations included:

   a. Hydraulic conductivities. SEE APPENDIX 6E
   b. Storage coefficients for confined aquifers and specific yield for unconfined. SEE APPENDIX 6E [Table 3-3]
   c. Transmissivities. SEE TEXT OF "SITE EVALUATION REPORT"
   d. Hydraulic gradients. SEE APPENDIX 6D
   e. Ground water velocities.
   f. Number of wells, borings, or test pits used. SEE APPENDIX 6C
   g. Maximum depth to regional water table or piezometric surface within the site with date of measurement. SEE APPENDIX 6D AND APPENDIX 5D
   h. Minimum depth to regional water table or piezometric surface within the site with date of measurement. SEE APPENDIX 6D AND APPENDIX
   i. Twelve month characterization of regional water table fluctuations, within the uppermost aquifer (four consecutive quarters). SEE APPENDIX 6D
   j. Description of perched or special water table conditions including seasonal high water table.
   k. Minimum depth to any perched water. N/A
   l. Effects of any deep mines in the area. SEE TEXT OF "SITE EVALUATION REPORT"
   m. Directions of ground water movement (shown on Phase I base maps) including description of how determined. SEE APPENDIX 6D
   n. Uses of aquifers. SEE § 3.1. OF "SITE EVALUATION REPORT"
   o. Ground water divides (shown on Phase 1 base maps) SEE APPENDIX 6D
   p. Three-dimensional ground water flow with discharge/recharge characteristics. SEE APPENDIX 6D

2. Proposed Ground Water Quality Monitoring Points (wells, piezometers, etc.) must be described in the following format and are subject to Department approval. Proposed monitoring points are to be permanently numbered in consecutive order. A "U" or "D" should be added to the monitoring point number to identify upgradient/downgradient. For existing monitoring points, information is to be based upon data obtained at completion; for new monitoring points, construction information is to be based upon specifications. Monitoring wells will be designed, constructed,

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I.D. Number

FORM 7R

and maintained in accordance with Sections 288.251, 291.521 and 289.261 (relating to general requirement(s)), Sections 288.252, 292.522 and 289.262 (relating to number, location and depth), and Sections 288.253, 291.523 and 289.263 (relating to standards for casing of wells) and consistent with the requirements of Form R18 (relating to Phase II Water Quality Monitoring System Information). Any proposed surface water monitoring point must have adequate flow to allow sampling even in the driest quarter of the year.

ALL MONITORING POINTS MUST HAVE AN ASSOCIATED LATITUDE AND LONGITUDE DETERMINED ACCURATELY TO THE NEAREST ONE TENTH OF A SECOND (DD° MM' SS.S")

SEE APPENDIX 5B

Wells and Piezometers

Monitoring Point Number	Drilling Method	Depth (ft)	Borehole Diameter (in.)	Casing		Location		Measuring Point Elevation (Ft/MSL)
				Diameter (in.)	Screened Interval (ft)	Latitude	Longitude	

Springs, Streams, Other Surface Water

Monitoring Point Number (Spring or Surface Water)	Elevation (Ft/MSL)	Flow Rate (GPM)	Date of Measurement	Location	
				Latitude	Longitude

SP - Spring
ST - Stream
S.W. - Surface Water

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Items 3 and 4 (below) pertain only to Residual Waste Landfills and Disposal Impoundments and Land Application Sites; not to Composting Facilities, Transfer Stations, Storage Facilities, Incinerators or other Processing Facilities.

3. Ground Water Quality Description

An application for a residual waste landfill or disposal impoundment must contain a description of the chemical characteristics of each aquifer in the proposed permit area and adjacent area, based upon at least two quarters of monitoring data, one of which shall be in the season of highest local groundwater levels of monitoring data. This requires at least two (2) sets of analyses on approximately a 90 day interval in the format of Form 8R. Proposed Mandatory Abatement Trigger Levels must be indicated in the designated column of Form 8R.

An application for a residual waste land application site may, at the Department's discretion, require a description of the chemical characteristics of each aquifer in the proposed permit area and adjacent area based upon at least two (2) sets of analyses for consecutive quarters (except land disposal) in the format of Form 9R. For land disposal, three consecutive sets of analyses on monthly intervals are required. Proposed Mandatory Abatement Trigger Levels must be indicated in Form 9R.

4. *Surface Water Information*

The application must contain a description of surface waters in the proposed permit area and adjacent areas including the questions posed below. The surface water information shall be based on a sufficient number of observations, calculations, weir, or flow meter readings and sample analyses to allow an accurate characterization of the physical, chemical, and biological characteristics of the surface waters.

Does the application include a description and map of the watershed in which the proposed permit area is located and other watersheds which may be affected by the proposed facility (including streams, springs, or wetlands that are representative of the surface and ground water system of the general area)?

Are surface elevations and rates of flow of streams, springs, seeps, and mine discharges in the proposed permit area and adjacent area included?

Is a description of the quality of surface waters which will receive flows from the surface or ground water of the proposed permit area included?

The following is not required for land application sites.

Has a description of the in-stream macroinvertebrate community in surface waters above and below the proposed permit area (within appropriate limits) been attached? Survey methods should follow the Department's Standardized Benthic Macroinvertebrate Field Collection Methods. The survey report should include the name and address of the biologist performing the survey.

APPENDIX 6A
STRATIGRAPHY

RI Sections 2.4, 2.4.1, 2.4.2, 2.4.3 and 2.4.4
RI Figures 2-4, 2-5 and 2-6
RI Table 2-1

As mentioned in Section 2.1, several coal mines are located near the Site. This activity has resulted in the production of acid mine water which has affected Pond Creek and Sandy Run. Oxidation of pyrite and marcasite, common minerals in coal, forms sulfuric acid in surface runoff waters which lowers the pH of the receiving surface water body. Acidic surface runoff water also increases the amount of dissolved solids and a number of metals, including iron, manganese and aluminum (McCarren, 1969; Taylor, 1984). For example, water samples obtained from Sandy Run and Pond Creek on July 12, 1960 had pH values of 3.4 and 4.3, respectively (McCarren, 1969). Total dissolved solids and metal concentrations in Lehigh River surface water samples are consistently higher at locations downstream of mine drainage influent when compared to upstream surface water locations (McCarren, 1969).

In Pond Creek, a pH reading of 5.4 was measured by HART in February 1989 at the bridge just downstream from the abandoned strip mine northwest of the Site. A light iron precipitate, indicative of acid mine drainage, was observed covering the rocks in the streambed. pH readings in the surface mine ponds which feed Pond Creek ranged from 4.3 to 4.9 when measured by HART in November 1988 and February 1989.

2.4 Geology

Rock formations exposed in the region range from Devonian shales of the Hamilton Group (oldest) to the Pennsylvanian Llewellyn Formation (youngest). These sedimentary rocks range from hard, coarse-grained conglomerates to soft, fine-grained shales. Pennsylvanian Formations (Pottsville and Llewellyn) contain coal-bearing units. A description of the composite stratigraphic sections for Luzerne County (Newport, 1977) is displayed as Table 2-1.

Table 2-1

Stratigraphic Information for Overburden and Bedrock in the Vicinity of the Site
C & D Recycling Site Remedial Investigation

System/Epoch	Group or Formation	Thickness (feet)	Lithologic Character	Water Bearing Properties
Quaternary				
Holocene	Alluvium	10	Soil, sand, gravel, and clay deposits in stream valleys.	Yields of wells range from 1 to more than 1,000 gpm, depending on the coarseness, degree of sorting, and thickness of deposits. Water is generally soft, except locally where water from coal mines has entered the deposits.
Pleistocene	Till	200	Clay, boulders, little stratification.	
	Outwash	300	Stratified sand and gravel, some clay lenses.	
Pennsylvanian	Llewellyn	2,200	Shale, sandstone, conglomerate, carbonaceous shale, and coal. Light to dark gray, well-indurated rocks.	Yields of wells range from 2 to 50 gpm. Water is generally of poor quality, high in acid and dissolved solids.
	Pottsville	300	Fine to coarse conglomerate, fine to coarse-grained sandstone siltstone, and thin shale and coal beds.	Yields of wells range from 5 to 150 gpm and average about 50 gpm. Water is generally soft and low in dissolved solids.
Mississippian	Mauch Chunk	2,000	Shale, siltstone, and fine to coarse-grained sandstone. Chiefly reddish to greenish shale predominates over lighter colored rock.	Yields of wells range from 5 to 250 gpm and if wells are more than 200 feet deep they generally yield 25 gpm or more. Water is soft and low in dissolved solids.

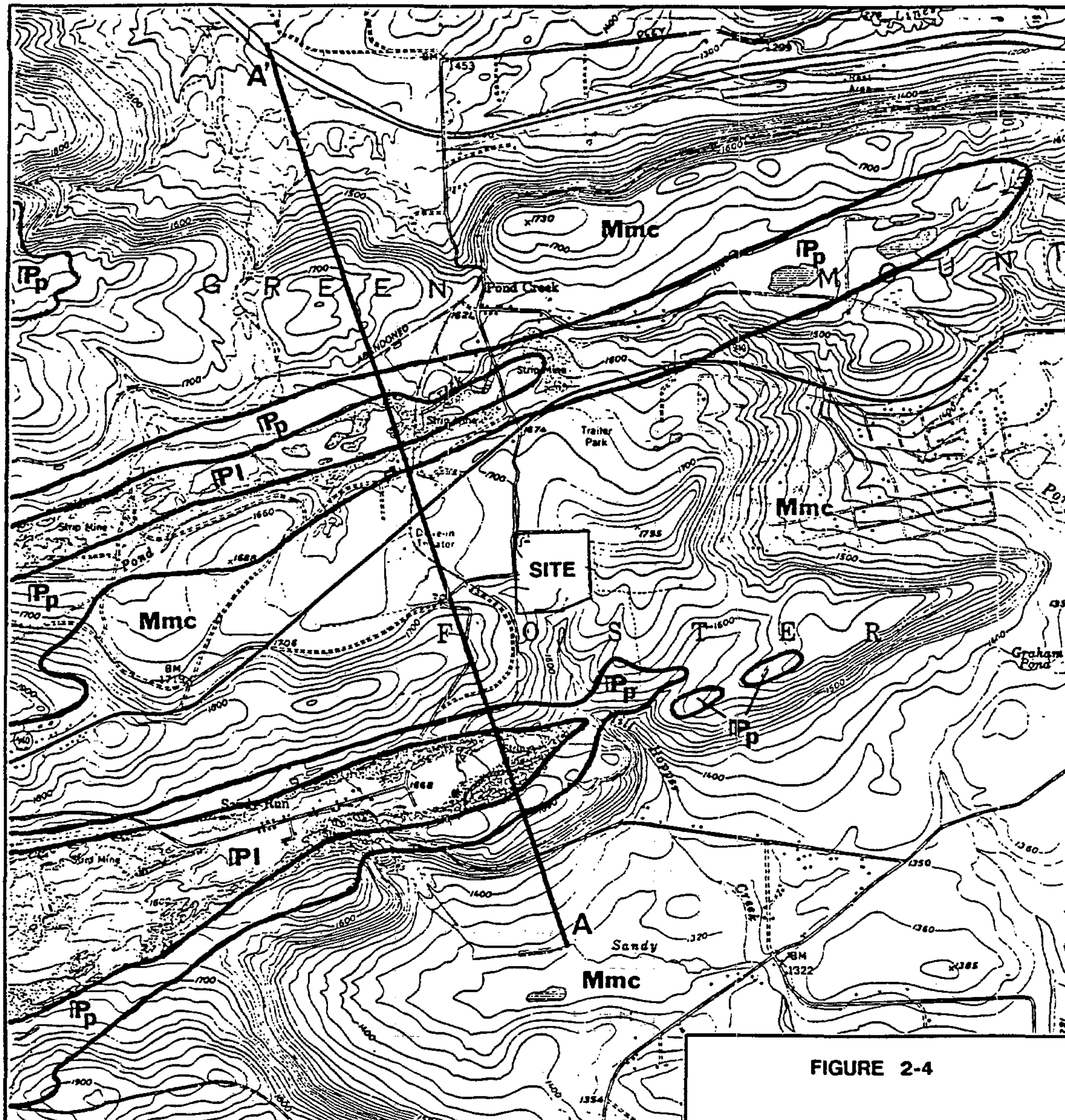
Source: Newport, Thomas G., Summary of Ground-Water Resources of Luzerne County, Pennsylvania, U.S. Geological Survey Water Resources Report 40, 1977.

The rock formations present in Luzerne County were folded and faulted during the Appalachian mountain building event at the end of the Paleozoic. This event also formed the hard anthracite coal for which the region is famous by compressing the existing coal deposits and driving off volatiles. However, present-day relief in the region is due as much to differential erosion as it is to folding. The differential erosional process erodes away softer shales to form valleys while ridges of resistant rock form topographic highs. In the vicinity of the Site, the hard quartz conglomerate of the Pottsville Formation and the massive, coarse sandstones and sandstone conglomerates of the Pocono Formation form high ridges. The red and green shales and fine sandstones of the Mauch Chunk, which lie between these two resistant units, form the area's valleys.

The Site is underlain by the Mauch Chunk Formation. Other bedrock units which outcrop in the vicinity of the Site include the Pottsville and Llewellyn formations. The drilling logs from on-site monitoring well installations indicate that weathered bedrock ranging in thickness from 8 to 18 feet is encountered within a few feet of the ground surface. This weathered material generally consists of brown clayey silt with larger fragments of red shale. A more competent bedrock is encountered below the weathered zone and consists of an inter-layered red and gray shale.

A portion of the Preliminary Geologic Quadrangle for White Haven, Pennsylvania is presented in Figure 2-4. The locations of the geologic cross-section A-A' (Figure 2-5) and the Site are shown in this figure. The geologic information from this quadrangle was used for the construction of the cross-section in Figure 2-5. The orientation of the geologic units is an interpretation based upon the limited information available from Figure 2-4 and local field reconnaissance by HART geologists.

The following sections will describe in more detail the bedrock formations and unconsolidated deposits that are present in the immediate vicinity of the Site.



KEY

Pl	– Llewellyn Fm.
Pp	– Pottsville Gp.
Mmc	– Mauch Chunk Fm.

Base of Mmc is very generalized.

2000 FT
SCALE

N

CONTOUR INTERVAL: 20 FT.

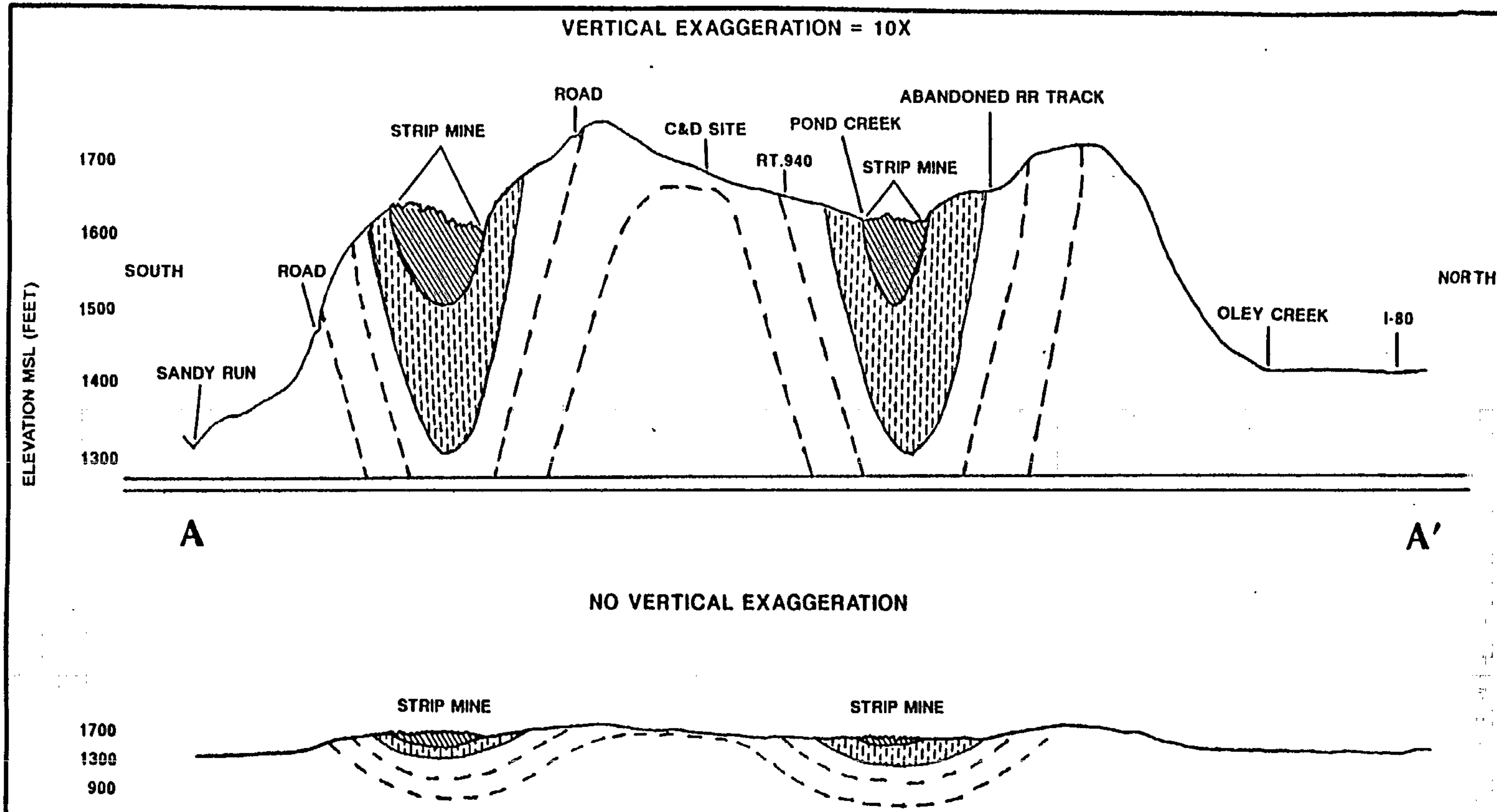
Compiled by W. D. Sevon, 1977, based on aerial photo interpretation.
Base Map: USGS 7.5' Quad., White Haven, PA (1947)

FIGURE 2-4

BEDROCK GEOLOGY

C&D RECYCLING SITE
REMEDIAL INVESTIGATION

FRED C. HART ASSOCIATES, INC.



FORMATION	AGE
LLEWELLYN FORMATION	PENN
POTTSVILLE FORMATION	PENN
MAUCH CHUNK SHALE	MISS

1000 0 1000 2000FT

HORIZONTAL SCALE

TOPOGRAPHY FROM USGS WHITE HAVEN QUADRANGLE

LINE OF SECTION ORIENTATION = N17°W (SEE FIGURE 2-4)

GEOLOGIC CONTACTS & STRUCTURE FROM SEVON(1975) AND HART FIELD RECONNAISSANCE

FIGURE 2-5
TOPOGRAPHIC & GEOLOGIC PROFILE PERPENDICULAR TO STRIKE

C&D RECYCLING SITE
REMEDIAL INVESTIGATION

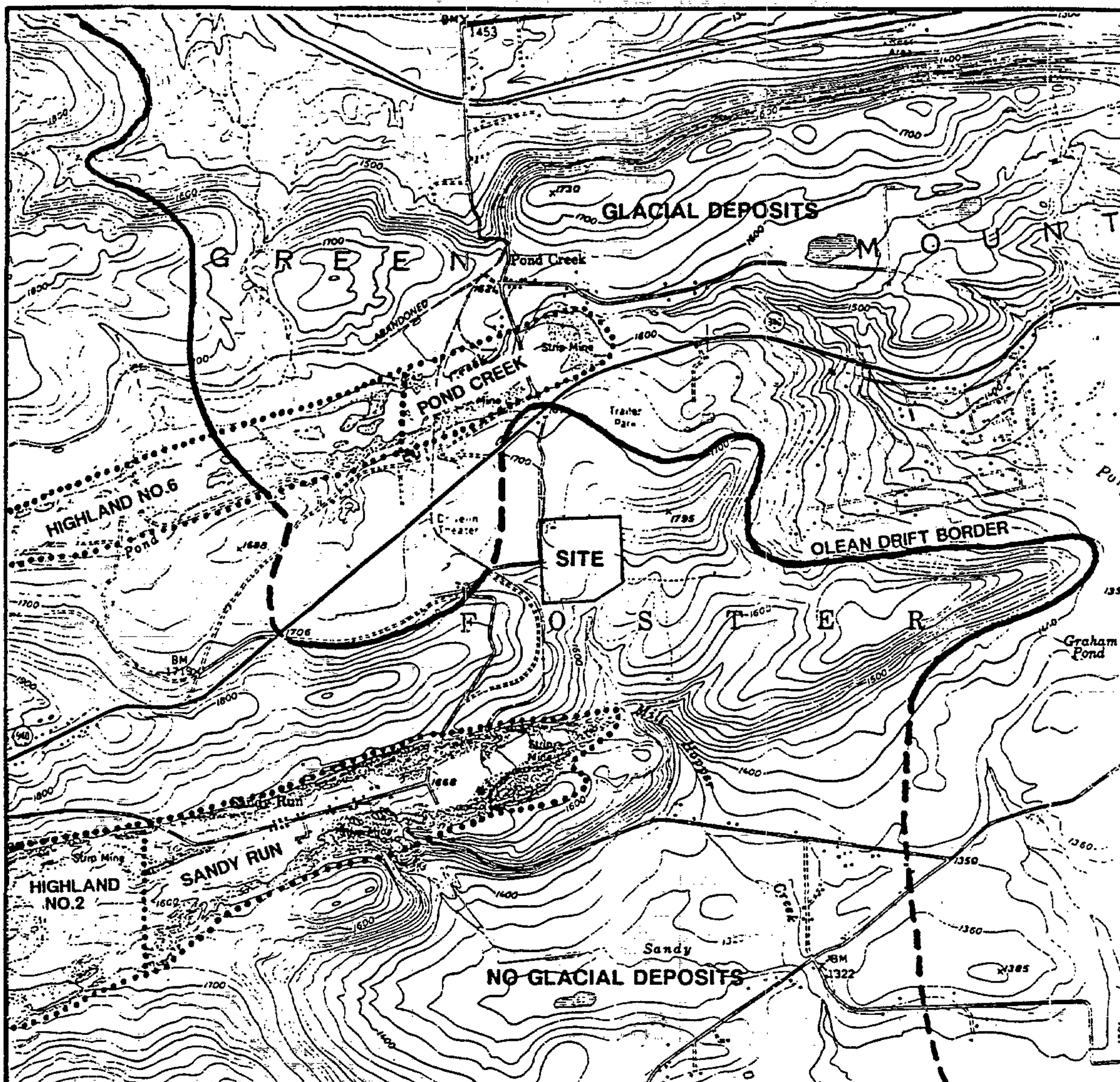
FRED C. HART ASSOCIATES, INC.

AR312904

2.4.1 Unconsolidated Deposits. Glacial deposits and limited amounts of alluvium overlie bedrock in the majority of Luzerne County. Glacial deposits consist mainly of dense, unsorted till; unstratified drift; and sorted outwash deposits. However, the southern portion of Luzerne County, including the Site, is south of the border defining the last glacial advance (Crowl, 1980). This border transects Luzerne County from Beach Haven to the southeast corner of the Lehigh River Valley. Figure 2-6 shows the location of the Olean Drift Border in the vicinity of the Site. Although no glacial deposits exist on-site, much of the area just north of the Site is covered by glacial till, drift and outwash deposits (Crowl, 1980).

Bedrock not covered by glacial deposits (south of the drift border) is often more deeply weathered then bedrock covered by drift. Severe breakage of bedrock along bedding planes and joints is common. This results in colluvium and talus deposits near slopes which are wedge shaped piles of broken rock that collect at the base of slopes and rock cuts.

2.4.2 Llewellyn Formation. The Llewellyn Formation is composed of interbedded light gray, quartz-pebble conglomerate; light to medium gray, fine to coarse grained sandstone; light to dark gray shale and siltstone; medium gray claystone; very dark carbonaceous shale; and anthracite coalbeds. The strata between the coalbeds often exhibit extreme lateral changes in thickness and lithology characterized by crossbedding, truncated bedding, and channel deposits. The most persistent strata are the coalbeds which range in thickness from a fraction of an inch to 27 feet (Hollowell, 1973). The formation contains at least 26 coalbeds (Ash, 1954). The thickness of this formation ranges up to 2200 feet in the Wyoming Valley to the north but in the vicinity of the Site erosion has removed nearly all of the Llewellyn rock leaving two narrow strips south of Pond Creek and at Sandy Run (Figure 2-4). In both cases, the Llewellyn occupies the axis of tight synclines (Figure 2-5). As a result, the well cemented sandstones and conglomerates are highly fractured due to their brittle



KEY

COAL MINE

2000 FT SCALE

N

OLEAN DRIFT BORDER
DASHED WHERE APROXIMATE
SOURCE: CROWL AND SEVON, 1980

Base Map: USGS 7.5' Quad., White Haven, PA (1947)

FIGURE 2-6

COAL MINE LOCATIONS AND GLACIAL DRIFT BORDER

C&D RECYCLING SITE
REMEDIAL INVESTIGATION

FRED C. HART ASSOCIATES, INC.

nature and tectonic pressures. Both areas have been mined for anthracite coal. The Highland No. 6 and Pond Creek underground mines are located north of the Site and the Sandy Run and Highland No. 2 underground mines are located south of the Site (see Figure 2-6). In addition, both of these areas have been extensively surface mined.

2.4.3 Pottsville Formation. The Pottsville Formation consists of gray conglomerate, conglomeratic sandstone, sandstone, siltstone, and some thin anthracite coalbeds. In much of its outcrop area the lower 20 to 50 feet consists of an almost continuous ledge of white to gray conglomerate (Taylor, 1984). Its thickness around the Wyoming Valley varies between 150 and 300 feet. In the vicinity of the Site the Pottsville Formation is about 500 feet thick, and the conglomerate is much coarser than it is in the Wyoming Valley. Coal beds occur in both regions in the Pottsville but few are of workable thickness (Lohman, 1937).

2.4.4 Mauch Chunk Formation. The Mauch Chunk Formation consists of greenish/brownish-gray to grayish-red siltstone and claystone, interbedded with an equal amount of brownish-gray to pale red, poorly cemented, fine grained sandstone. Medium-grained to finely conglomeratic sandstone occurs locally (Taylor, 1984). The red claystone and sandstone constitute the greater part of the formation in the southern part of the Luzerne County whereas the greenish-gray claystone and sandstone predominate to the north.

The Mauch Chunk is composed of lithified subaerial delta deposits which may reach 2000 feet in thickness (Lohman, 1937). To the north, the formation thins and then pinches out northeast of the Wyoming Valley. The unit crops out around nearly all of the anthracite fields and generally forms valleys because it is soft and lies between two exceptionally hard rock formations (Newport, 1977).

APPENDIX 6B
SUBSURFACE CHARACTERISTICS

RI Sections 3.5.4.2, 3.5.4 and 3.5.4.1
RI Figures 3-8, 3-9 and 3-10

As can be seen in Figures 3-9 and 3-10 the most common lithology is the mudstone facies and fractures are concentrated near the top of the vertical sequence. Carbonates including both calcite and dolomite are found in several of the cores at varying depths in the vertical sequence. The carbonates are commonly found as intergranular cement, pore and fracture filling cements and in a few areas they constitute the primary rock forming mineral. Much of the carbonate rock contains a small percentage of fine grain terrigenous clastic material such as clay and quartz grains.

The cores revealed a series of fining upward sedimentary sequences interpreted to have been deposited in a fluvial or fluvio-deltaic setting. The dolomite lithologies are interpreted to have formed on paleo-topographic highs as a result of subaerial exposure and evaporation.

3.5.4.2 Porosity, Fractures and Reservoir Characteristics. Throughout the vertical sequence, primary porosity in the siltstone and sandstone facies is commonly occluded by calcite and silica pore filling cements. The coarser grained sandstone rarely displays primary interparticle porosity. Some solution enlarged pores occur in the carbonate rich intervals, but these are rare and do not form a suitable pathway for fluid migration. While porosity may be high in the mudstone facies, permeability is very low in the absence of fractures.

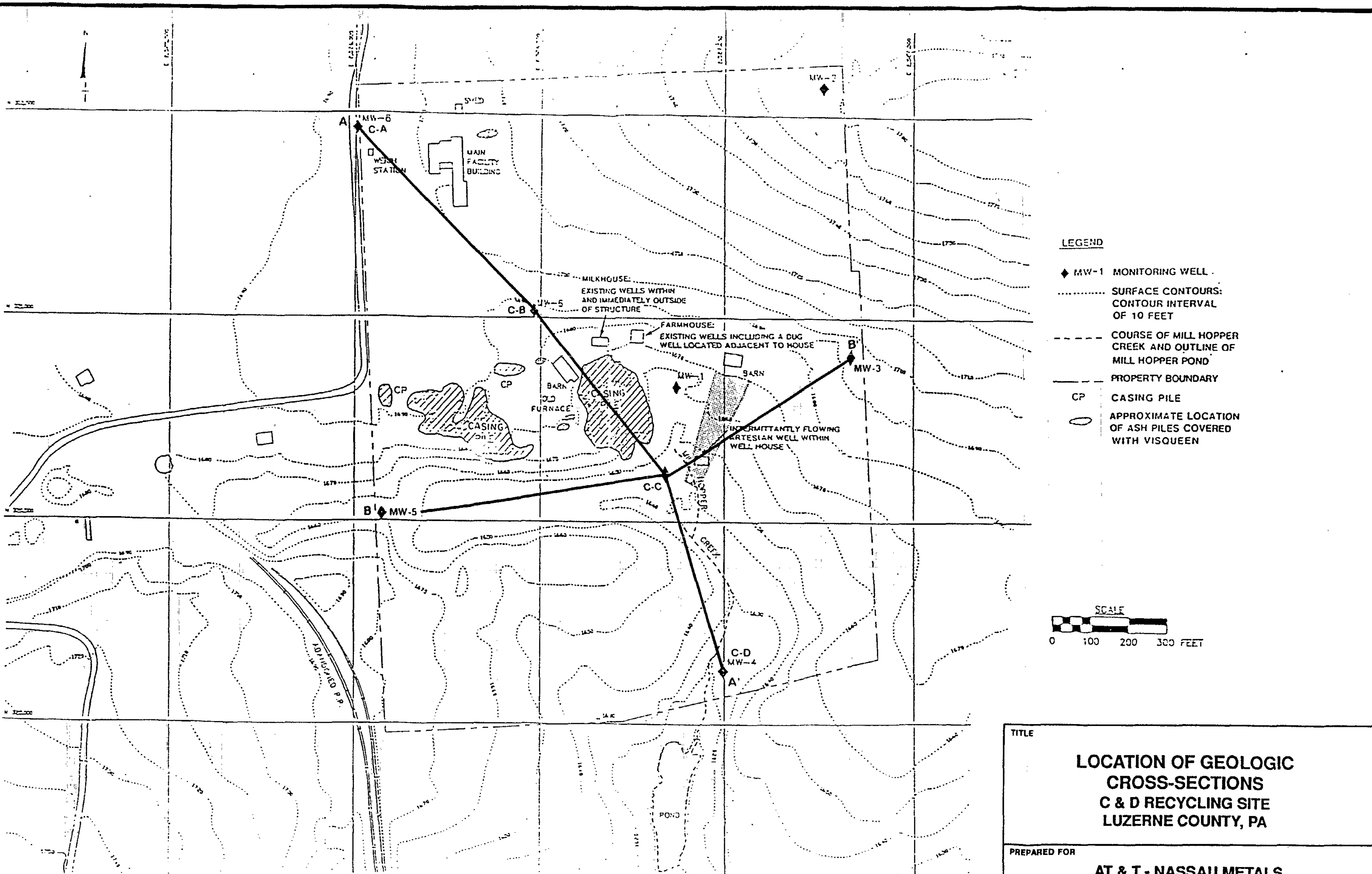
Because of the presence of pore filling cements and the well indurated nature of the bedrock it is apparent that the bedrock aquifer must be controlled primarily by the fracture system developed within the critical stratigraphic unit. Fractures were found in all the coreholes and were most common within the mudstone and siltstone facies. The fractures were commonly horizontal or near horizontal although vertical and oblique fractures were present but much less common. Calcite mineralization formed slickenside striae on a few low angle fractures indicating fault movement along these planes. The slip direction could not be determined from the cores. Detailed rock core descriptions can be found in Appendix D.

In several boreholes the air hammer, in conjunction with the surge tool, was used to predevelop. The drill bit was lowered to approximately two feet from the bottom of the borehole. Compressed air was used to lift and drop the standing column of water within the borehole. This freed loose material from the borehole walls. The column of water was lifted and dropped several times and eventually forced out of the borehole along with all of the suspended solids in the column. The borehole was allowed to recharge with groundwater before this process was repeated. Continuing this process predeveloped the desired zone and cleaned the borehole walls of drill cuttings. Surge tool predevelopment was conducted after the predevelopment with the air hammer provided there was enough water in the borehole. Table 3-11 summarizes predevelopment at each location.

3.5.4 Discussion. The information gathered during the geological investigations can be summarized under the following two categories: stratigraphy and sedimentology and porosity, fractures and reservoir characteristics. A brief summary discussion of each of these categories follows.

Figure 3-8 shows a map of the Site with cross sections A-A' and B-B' depicted in their relative positions. These cross-sections (Figures 3-9 and 3-10) were generated from data derived from coring and the geophysical survey conducted in the existing monitoring wells.

3.5.4.1 Stratigraphy and Sedimentology. Geophysical well logs and rock cores collected during the geologic investigation reveal a common Mauch Chunk stratigraphy consisting primarily of thick to massively bedded reddish-brown mudstone and siltstone with minor thin interbedded grey sandstones of varying grain size. Cross-bedding is commonly seen in the coarser grained facies while the fine grained rocks generally show no sedimentary features. Weathered bedrock (primarily red siltstone) is found at the top of the vertical sequence throughout the Site. Figures 3-9 and 3-10 depict north-south and east-west cross-sections respectively. The cross-sections show the 1988 packer test intervals for the existing monitoring wells.



ADAPTED FROM: McLAREN/HART - 1991

TITLE

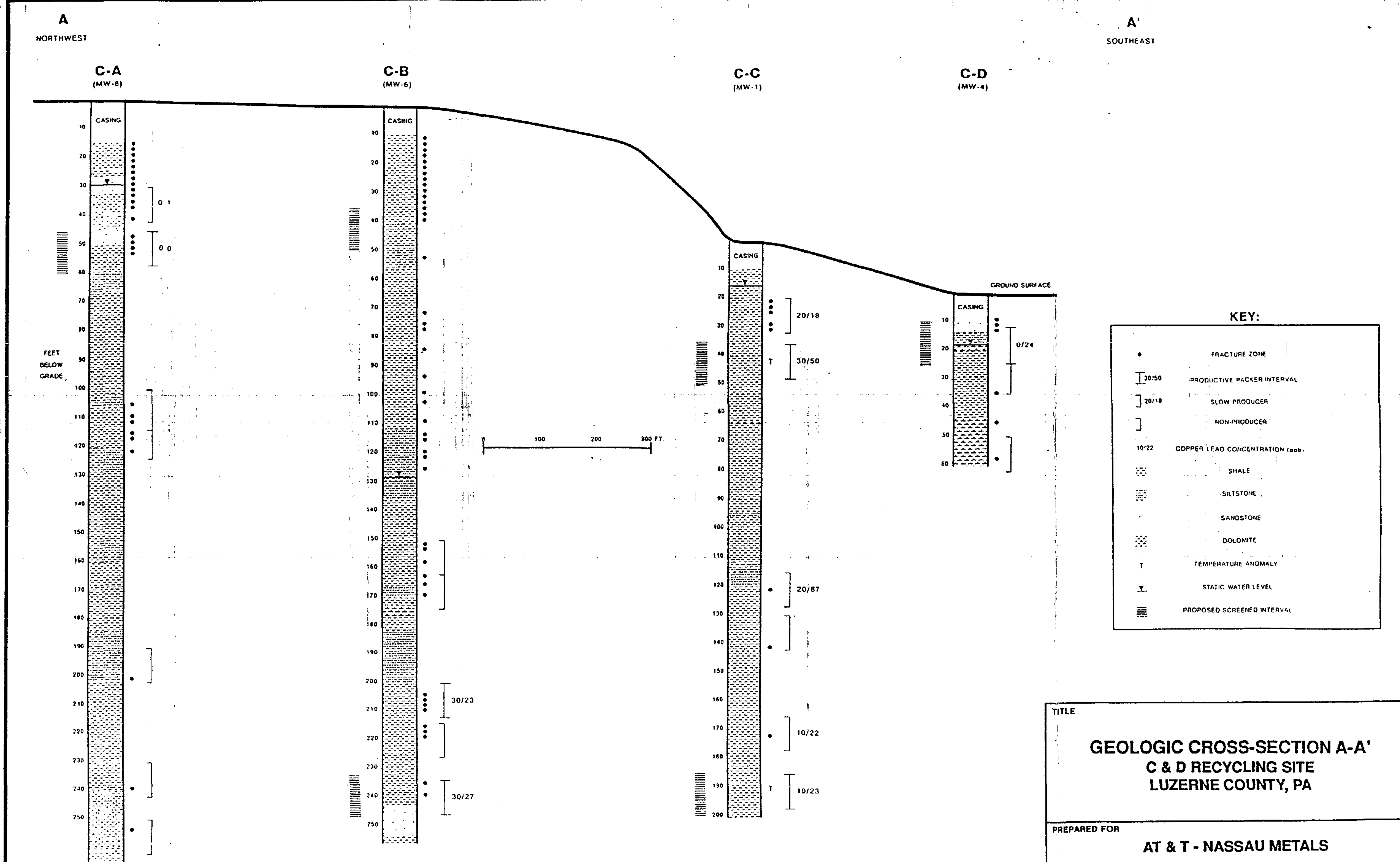
LOCATION OF GEOLOGIC CROSS-SECTIONS
C & D RECYCLING SITE
LUZERNE COUNTY, PA

PREPARED FOR

AT & T - NASSAU METALS

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
Noted	3-8
DATE 5/1991	



ADAPTED FROM: McLAREN/HART - 1991

TITLE

GEOLOGIC CROSS-SECTION A-A'

C & D RECYCLING SITE
LUZERNE COUNTY, PA

PREPARED FOR

AT & T - NASSAU METALS

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
Noted	3-9
DATE 5/1991	

160988

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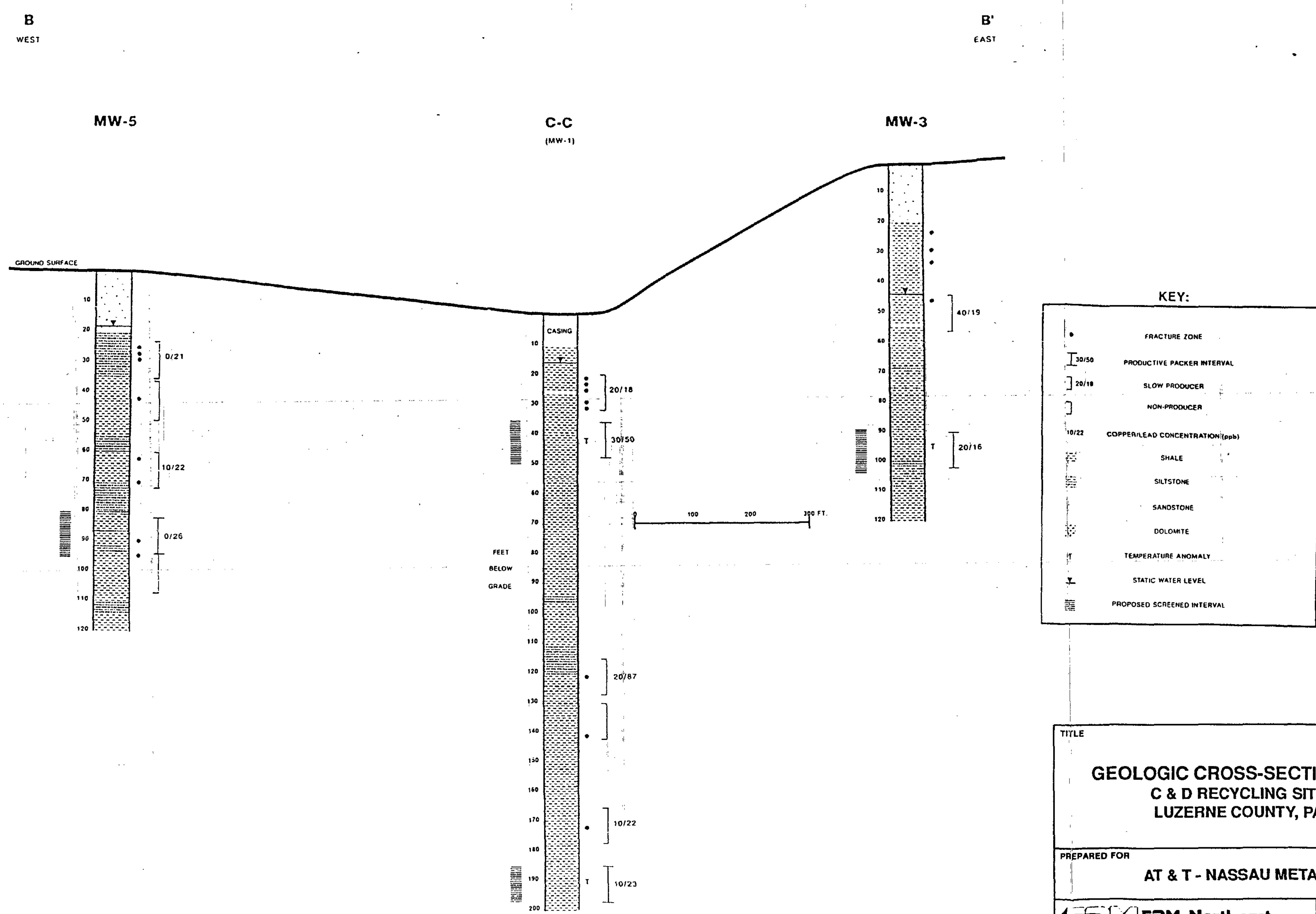


ADAPTED FROM: McLAREN/HART - 1991

TITLE

GEOLOGIC CROSS-SECTION B-B'
C & D RECYCLING SITE
LUZERNE COUNTY, PA

PREPARED FOR

AT & T - NASSAU METALS

ERM-Northeast
Environmental Resources Management

SCALE	FIGURE
Noted	3-10
DATE 5/1991	

APPENDIX 6C
BORING AND CORE LOGS

RI Appendix D
FS Appendix E

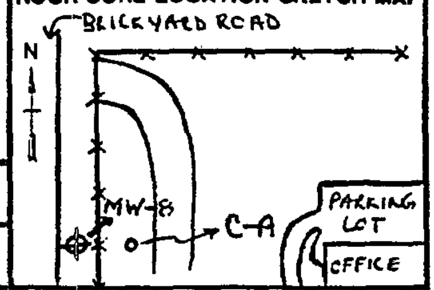
FRED C. HART ASSOCIATES, INC.

HART

ROCK CORE LOG

BORING NO. C-A

ROCK CORE LOCATION SKETCH MAP



PROJECT NO./NAME 01023 18 0000903/AT&T NASSAU

LOCATION FREELAND, PA.

HART GEOLOGIST/OFFICE S.F. VERSCHEL, H HATFIELD / ALBANY

START/FINISH DATE 7/19-7/25 1988

DRILLING CONTRACTOR PARATT WOLFF

DRILLING EQUIPMENT MOBILE DRILL B-57

DRILLER BILL RICE

CORE BIT SIZE NX 3" OD

WATER SOURCE FREELAND WATER AUTHORITY

WELL INSTALLED? YES ☐ NO ☒

T.D.-BOREHOLE 265'

NO. OF CORE RUNS 33

THICKNESS AND TYPE OF OVERBURDEN 8' OVERBURDEN RED SILTY SOIL WITH ROCK FRAGMENTS

REMARKS:

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOG	REMARKS
15–20	1	2, 3, 3, 2½, 3	4.8	96	32	RED SHALE - NUMEROUS WEATHERED FRACTURES (TOTAL 17 IN 5') VUGGY PORES AT 16.5' WAVY LAMINAE PRESENT AT 16.5 TO 17.5'. FINE HAIR LIKE VERTICAL FRACTURE PRESENT AT THIS DEPTH ALSO. FRACTURED VUGGY SHALE CONTINUES TO 20 FT.	0° TO 45°	W W	1" TO 4"		
20–30	2	3, 3, 2, 1½, 1, 2, 2, 1½, 1, 1½	8.7	87	32.5	RED SHALE WITH NUMEROUS WEATHERED FRACTURES TO 22.7'. BECOMES SILTY AT 22.7' AND REMAINS RED AND SILTY TO 24.4'. FROM 24.4' TO 30' RED COLOR FADES (CLAY LOSS) AND CORE BECOMES SILTY SANDSTONE. SANDSTONE TANNISH GRAY WITH BLACK SPECKLING. RELATIVELY FRIABLE LOOSELY CEMENTED FRACTURE SPACING INCREASED TO 4" TO 5" SANDSTONE CONTAINS QUARTZ (ROUNDED) MAFICS AND MICA FLAKES. SANDSTONE FINES UPWARD TO SILTSTONE THEN SHALE (GRADATIONAL CONTACTS).	0°; 0° 45° + 90°	W; W	1"; 4" TO 5"		
30–35	3	2, 2, 2½, 2½, 3				FRIABLE SILTY SANDSTONE WITH DARK COLORED HORIZONTAL BANDING. NUMEROUS HORIZONTAL FRACTURES WITH SPACING OF ½" TO 2". SHARP CONTACTS BETWEEN SANDSTONE AND SHALE AT 31.7' SHALE IS DEEP RED COLOR WITH HORIZONTAL TO SLIGHTLY OBLIQUE LAMINAE CONTAINING SILT	0°	W			

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

Depth	Run No.	Core Time (Mins)	Recovery (Ft.)	% Recovery	RQD (%)	Rock Core Description	Cracks: Angle	Cracks: Cond.	Cracks: Spacing	Graphic Loc.	Remarks
35–40	3	2 3½ 3½ 4 2½	7.5	75	40	RED SILTY SHALE continues to base (40.0') with 45° fractures and horizontal fractures	0° to 45°	W	2" to 4"		
40–50	4	2 1½ 2½ 6 4 6½ 5½ 3 3 2	9.8	98	46.5	RED SILTSTONE with horizontal fractures 0.1" to 6" spacing. Gray siltstone beds showing multiple horizontal laminae and mica flakes. Dark (mafic mineral) bands at 42.7'. 3" to 4" fracture zone with partial calcite filling and red clay at 43.7'. Well lithified siltstone at 44.0' and continuing to 46.7'. Cross-bedded siltstone to medium sandstone at ~47.0'. Shallow vuggy pores at 49.0 - 50.0' porous.	0° 0° to 45°	W W	0.1" to 6" 3" to 6"		Porous, permeable sandstone
50–60	5	4 5 3½ 4½ 7 9 4 5 5 5	9.3	93	49.5	MICACEOUS SANDSTONE continues for first 3.5". Sharp contact with red shale. Vuggy pores in shale, numerous horizontal fractures. Fracture zone with rubble at 52.3' to 52.7'. Porous and fractured red shale continues to 54.0' Shale becomes better lithified and less fractured to 56.85' possible fossil tests filled with calcite. Core becomes gray, hard siltstone from 56.85' to 60.0'. Low porosity and permeability minor fractures at 59.7'	45°	W	2"		Possible water producing zone
60–65	6	8 4 4 6½ 3½				HARD RED GRAY SILTSTONE low porosity and permeability. Rare horizontal fractures primarily drillers breaks; a few natural	45°	CS	N/A		Required bit change to increase drill penetration rate. Changed to a finer bit at 65'

CS - Clean & Smooth

AR312916

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

Depth	Run No.	Core Time (Mins)	Recovery (Ft.)	% Recovery	RQD (%)	Rock Core Description	Cracks: Angle	Cracks: Cond.	Cracks: Spacing	Graphic Loc.	Remarks
65–70	7	4½, 5½, 6, 9, 7	5.2	104	93	HARD RED GRAY SILTSTONE WITH MICA FLAKES. HARDNESS OF THIS FACIES AND PRESENCE OF MICA FLAKES SUGGESTS POSSIBLE LOW GRADE METAMORPHISM. SHARP CONTACT BETWEEN HARD RED-GRAY SILTSTONE AND UNDERLYING RED SHALE AT 66.1'. RED SHALE HAS NUMEROUS CALCITE BLEBS POSSIBLY AFTER ANHYDRITE. A FEW DOLOMITE BLEBS ARE ALSO PRESENT BUT SCATTERED	0°	C	2" TO 10"		NOT A LIKELY WATER PRODUCING ZONE
70–75	8	9, 8, 4, 6, 8	4.96	99	92	RED SHALE WELL LITHIFIED WITH NO NATURAL FRACTURES. OCCASIONAL DOLOMITE BLEB. NO OBVIOUS BEDDING, LAMINAE, ALLOCHEMS	N/A	N/A	N/A		DRILLERS BREAKS ONLY. LOW POROSITY LOW PERMEABILITY. CHANGE TO COARSE BIT
75–80	9	4, 6, 5, 4, 5	5	100	100	RED SHALE WITH WAVY HORIZONTAL LAMINAE. CLOSED VERTICAL FRACTURE AT 76.0'. HORIZONTAL FRACTURES DUE TO DRILLERS BREAKS. A FEW CALCITE BLEBS, SCATTERED DOLOMITE BLEBS. DENSITY OF CALCITE BLEBS INCREASES AT 78.05' AND 81.6'	90°	CL	N/A		100% RECOVERY
80–85	10	4, 3, 3, 4, 4	5	100	100	FRACTURES PARALLEL TO BEDDING TO DRILLERS BREAKS. RED SHALE WITH WAVY LAMINAE CONTINUES TO 85.0' WITHOUT CHANGE.					ONLY DRILLERS BREAKS
85–90	11	4½, 5, 6, 5, 5	4.4	88	68	RED SHALE WITH A FEW WISPY LAMINAE. WEATHERED HORIZONTAL FRACTURES AT 87.0'. WAVY HORIZONTAL LAMINAE COMMON TO 90.0'. CALCITE BLEBS AT 88.0'. A FEW SCATTERED DOLOMITE BLEBS.	0°	W			HORIZONTAL FRACTURING. 88% RECOVERY
90–91	12	5	1.55	>100	100	RED SHALE ONLY DRILLERS BREAK	N/A	N/A	N/A		
91–95	13	6, 10, 6, 10	8.8	97	89	RED SHALE WITH SIX NATURAL FRACTURES AND SCATTERED DOLOMITE BLEBS.					RUN 13 8.8' RECOVERY (97%) 91.0' TO 100.0' RQD 89%

C = CLEAN
CL = CLOSED
W = WEATHERED

AR312917

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	CRACKS GRAPHIC LOC.	REMARKS
95–100	13	10, 8, 7, 8, 8	8.8	97	89	RED SHALE CONTINUES TO BASE OF RUN 13. WELL LITHIFIED, NO VISIBLE POROSITY, PERMEABILITY (MATRIX) PROBABLY LOW.	0°	C	13"		MUCH DIFFICULTY WITH CORING DURING THIS RUN
100	14	N/A	1.2	120	100	RED SHALE, NO FRACTURES	N/A	N/A	N/A		
100–105	15	6, 10, 6, 6	4.05	101	100	SHALE BECOMES MORE SILTY AND VERY WELL LITHIFIED. ONLY DRILLERS BREAKS NOTED.	N/A	N/A	N/A		
105–110	16	9, 5, 6½, 7, 7½	5.1	110	72	RED SHALE WITH SCATTERED FOSSIL TESTS (CALCITE BLEBS) NATURAL FRACTURES AT 106.2', 106.7', 108.7', 108.8'. FAINT HORIZONTAL LAMINAE VISIBLE VERY FINE (CLAY), NO SILT	0°	C	0.1" TO 1.0"		WATER LOSS @ 106.3' POSSIBLE WATER ZONE
110–120	17	8, 5, 6, 6, 7, 7, 6, 7, 6, 6	9.8	98	94	RED SHALE WITH FAINT HORIZONTAL LAMINAE. CLOUDY BANDING AT 112.8' TEN NATURAL FRACTURES (HORIZONTAL) IN SIX DISTINCT ZONES AT DEPTHS OF 111.3', 113.0', 113.7', 114.4', 114.9' AND 115.3'. SLIGHTLY OBLIQUE FRACTURES SHOWING CALCITE MINERALIZATION ON SURFACE. SLICKENSIDE STRIATION WITH DEXTRAL OFFSET DETERMINED BY CALCITE CRYSTAL GROWTH. PYRITE PRESENT ON FAULT PLANES ALSO	0°; 20° TO 30°	C; Ca	0.1" TO 1.0"; 2"		FAULT; FAULT; FAULT; POSSIBLE WATER ZONE
120–125	18	7, 5, 5, 5, 7	10	100	94.6	SILTY RED SHALE WITH FAINT LAMINAE BECOMES MORE SILTY AT 120' AND DISPLAYS CROSS-LAMINAE. FRACTURE AT 121.25' WITH CALCITE MINERALIZATION FRACTURES WITH CALCITE ALSO AT 121.5' SILTY CALCAREOUS SHALE GRADES TO A PELOIDAL INTRACLASTIC BIOCLASTIC WACKESTONE	0°; 0°	Ca; Ca	3"; 1"		

AR312918

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
125–129.6	18 (CONT)	7 7 8 8	10	104	94.6	WACKESTONE CONTINUES FROM 121.7 TO 122.4'. GRADES BACK TO CALCAREOUS SILTY SHALE THEN WACKESTONE BEGINS AGAIN AT 123.3' CONTINUING TO 124.9'. RED PELLOIDS CONTINUE TO BASE OF RUN AT 129.6'. FRACTURES HORIZONTAL AT 125.0'	0° 0°	C	1" TO 2"		
129.6–134.2	19	10 7 7 5 2	4.4	96	100	RED CALCAREOUS SHALE (PELOIDAL WACKESTONE) WITH SCATTERED BLUE-GRAY DOLOMITE BLEBS AND CALCITE NODULES AFTER ANHYDRITE. LOW POROSITY/PERMEABILITY DRILLERS BREAKS ONLY	N/A	N/A	N/A		40 FT OF CASING NOW IN HOLE
134.2–140	20	4 4 7 6 5 6	5.8	100	100	RED SHALE (WACKESTONE) NON-CALCAREOUS WITH CALCITE BLEBS INTRACLASTS OR REPLACEMENT FOR ANHYDRITE. SHALE CONTINUES WITHOUT DISTINGUISHING FEATURES TO BASE OF RUN AT 140.0' DRILLERS BREAKS ONLY BECOMING MORE SILTY AND SLIGHTLY GRAY IN COLOR AT 139.0'	N/A	N/A	N/A		
140–150	21	6 5 5 6 6 6 5 5 4 5	10.0	100	100	RED SILTY SHALE NON CALCAREOUS. PELOID VISIBLE IN MANY AREAS (MUDSTONE TO WACKESTONE). SMALL CALCITE BLEBS, FOSSIL TESTS AND CALCITE REPLACING EVAPORITE NODULES. RARE BLUE-GRAY DOLOMITE BLEBS. FAINT HORIZONTAL LAMINAE DRILLERS BREAKS IN ALL CASES WITH EXCEPTION OF 147.3' WHICH IS NATURAL VERY WELL LITHIFIED, COMPETENT ROCK	0°	C	N/A		NOT A WATER PRODUCING INTERVAL CORE 7.35' IN LENGTH RECOVERED IN THIS RUN.
150–155	22	9 9 6 5 6	10.0	100	94.5	RED SHALE - HARD, WELL LITHIFIED WITH RARE DOLOMITE BLEBS BECOMES SILTY AND GRAYISH AT 151.7' AND SHOWS CROSS-LAMINAE TO 155.4'. SILTY ZONE IS NON-CALCAREOUS MOSTLY DRILLERS BREAKS	0°	C	0.1"		

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	GRAPHIC LOC.	REMARKS
155–160	22 (CONT)	7 7 9 9 7	10.0	100	99.5	RED SHALE CONTINUES TO BASE OF RUN AT 160.0'. MINOR SILT IN MATRIX OF PELOIDAL CLAYSTONE. RARE THIN HEALED MICROFRACTURES (VERT). PRIMARILY DRILLERS BREAKS	90° 0°	H (MF) C	 0.1"		
160–170	23	5 5 5 5 6 6 7 7 7 7	10.0	100	95	RED MUDSTONE TO SILTSTONE, FAINT CLOUDY BANDS IN UPPER 2.0' OF RUN WITH DISTINCT LAMINAE VISIBLE AT 163.0'. HORIZONTAL PARTING ON BEDDING PLANES AT 163.0' AND 163.1'. FINE HEALED MICROFRACTURES AT 164.9'. THERE ARE NUMEROUS CALCITE BLEBS WHICH ARE INTRACLASTS, FOSSILS AND/OR REPLACEMENTS OF EVAPORITES. SHARP CONTACT BETWEEN RED MUDSTONE ABOVE AND GRAY RED SILTSTONE BELOW AT 167.2'. SILTSTONE COARSENS DOWNWARD, IS SLIGHTLY CALCAREOUS (CEMENT) AND DISPLAYS CROSS-LAMINAE	0° 45° TO 90°	C H (MF)	1.5"		
170–180	24	7 9 6 7 6 6 6 8 6 7	9.9	99	97	SILTSTONE ENDS AT 170.35'. RED MUDSTONE BEGINS. MUDSTONE DISPLAYS WAVY LAMINAE OF CALCAREOUS SILT. CALCITE BLEBS (FOSSIL TESTS) 173.0' TO 174.0' SILTY HORIZONTAL LAMINAE PERSISTS TO 177.7'. NUMEROUS CALCITE BLEBS FROM 178.0' TO BASE OF RUN AT 180.0'. HORIZONTAL FRACTURES PARALLEL TO BEDDING	0°	C	0.5" TO 10"		
180–185	25	6 8 6 5 5	10.0	100	100	RED SHALE (MUDSTONE) WITH FEW CALCITE BLEBS (FOSSIL TESTS) DARK AND LIGHT MOTTLING. WAVY LAMINAE CONTAINING SILT AT 181.5'. CORE REMAINS SILTY TO 188.5'. ONLY DRILLERS BREAKS. SCATTERED DOLOMITE BLEBS	N/A	N/A	N/A		

H = HEALED
(MF) = MICRO FRACTURE
C = CLEAN

AR312920

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
185–190	25 (CONT)	5, 5, 4, 6, 5	10.0	100	100	GRAY SILTSTONE FROM 188.5' TO BASE OF RUN AT 190.0'	N/A	N/A	N/A		DRILLERS BREAKS ONLY
190–192.5	26	6, 5, 6, 6				RED GRAY SILTSTONE WITH VISIBLE CROSS-LAMINAE. DRILLERS BREAKS ONLY, NO NATURAL FRACTURES	N/A	N/A	N/A		ONLY 3.5' RECOVERED OF 10.0' DRILLED DUE TO WEAK SPRING RETAINER <6' CORE IN HOLE
192.5–200	26A	7, 5, 6, 9, 6, 6	6.4	99	95	RED TO RED-GRAY SILTSTONE GRADING TO RED MUDSTONE NEAR 200.0'. THIS 5' SECTION HAS BEEN REDRILLED AND SHOWS EFFECTS OF UNEVEN BIT CUTS. ONE OPEN FRACTURE AT 200.0'	80°	C	N/A		
200–210	27	6, 6, 5, 8, 7, 7, 8, 7, 6, 7	10.0	100	100	GRAY SILTSTONE WITH HEALED MICRO-FRACTURE TO 200.6'. SILTSTONE SHOWS CROSS LAMINAE AND IS CALCAREOUS. SHARP CONTACT WITH RED MUDSTONE CONTAINING CALCITE BLEBS. WAVY LAMINAE AND CROSS LAMINAE TO BASE OF RUN. WAVY LAMINAE MAY BE OF ALGAL ORIGIN OR DUE TO CONTRASTING GRAIN SIZE SILT/CLAY AND DEWATERING DURING DEPOSITION. RARELY FINE PORES CAN BE SEEN WITHIN LAMINATED SEQUENCE. DRILLERS BREAKS PREDOMINANT. UNLIKELY WATER ZONE. POSSIBLY FOSSILIFEROUS NEAR BASE	90° 45°	H MF C	N/A N/A		
210–215	28	6, 7, 6, 6, 6	10.0	100	100	RED MUDSTONE (SHALE) WAVY LAMINAE CONTINUES TO 212.0'. NUMEROUS CALCITE BLEBS ARE VISIBLE TO 214.4'. SHARP CONTACT AT 214.9' WITH GRAY SILTSTONE WITH CROSS-LAMINAE	N/A	N/A	N/A		

AR312921

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
215–220	28 (CONT)	7, 7, 8, 7, 6	10.0	100	100	RED MUDSTONE WITH CALCITE BLEBS AT 216.6'. RED GRAY SILTSTONE BEGINS AGAIN AT 217.65' AND CONTINUES TO BASE OF RUN. NO NATURAL FRACTURES	N/A	N/A	N/A		7.75' CONTINUOUS CORE RETRIEVED
220–230	29	4, 5, 4, 4, 5, 4, 5, 5, 4, 5	10.0	100	100	GRAY TO REDDISH GRAY SILTSTONE HEALED CALCITE MICROFRACTURES. RARE DOLOMITE/CALCITE BLEBS. CONTENT OF CLAY INCREASES AT 223.0' AND CORE DISPLAYS CALCITE BLEBS (FOSSIL TESTS) AND WHITISH CALCITIC MOTTLING AND BANDING. CLOSE FRACTURE AT 224.7 LIGHT GRAY CALCAREOUS SILTSTONE WITH CLAY LAYERS, BEDS, LAMINAE AND BLEBS LOW POROSITY, NOT VERY FRACTURED, PROBABLY LOW PERMEABILITY FINE WAVY LAMINAE NEAR BASE OF RUN	~80°	CL	N/A		
230–240	30	6, 6, 5, 5, 4, 5, 5, 4, 4, 4	10.0	100	100	NON-CALCAREOUS RED SHALE, WELL INDURATED, WITH MICA FLAKES UP TO 0.5mm IN DIAMETER. WAVY LAMINAE AND CROSS LAMINAE FAINTLY VISIBLE. CLAY CONTENT VARIES THROUGHOUT CORE RANGING FROM VERY HIGH IN THE RED SHALE ZONES TO LESS THAN 50% IN THE SILTY GRAY ZONES. THERE IS NO OBVIOUS EVIDENCE OF QUARTZ GRAINS IN THE SILTY INTERVALS, HOWEVER, TEXTURE IS COARSER THAN THE SHALES AND COLOR CHANGES TO GRAY. SOME GRAY AREAS REACT TO HCl, OTHERS DO NOT. THE HARDNESS OF THE ROCK AND THE SIZE OF THE MICA FLAKES SUGGEST POSSIBLE LOW GRADE METAMORPHISM WITH CLAYS SUCH AS ILLITE FORMING MUSCOVITE	60°	CL	N/A		VERY WELL INDURATED MICA FLAKES CROSS-LAMINAE
240–245	31	4, 4, 4, 5, 6	10.0	100	100	240.0' TO 240.35' HARD SLIGHTLY CALCAREOUS GRAY CRYSTALLINE ROCK WITH FINE MICA FLAKES RED SHALE AND SILTSTONE FROM 240.35' TO 240.45'. CORE BECOMES BLUE-GREEN GRAY COLOR AND IS CRYSTALLINE (METAMORPHIC?) ROCK CONTAINING DOLOMITE AND MAFIC MINERALS (BIOTITE?) LOW GRADE METAMORPHISM	N/A	N/A	N/A		10.0' CORE RECOVERED WITH NO FRACTURES OR DRILLERS BREAKS

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-A

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
245–250	31 (CONT)	4 5 4 4 5	10.0	100	100	BLUE GRAY CRYSTALLINE DOLOMITE VERY HARD, WITH MICA FLAKES RECRYSTALLIZED UNDER LOW GRADE METAMORPHISM. FINE CRYSTAL SIZE. NO FRACTURES NO DRILLERS BREAKS					NO WATER PRODUCTION
250–260	32	5 6 6 5 5 3 4 3 4 5	9.9	99	100	DARK GRAY FINE GRAINED CRYSTALLINE ROCK. MICA FLAKES VISIBLE BUT NOW VERY SMALL. APPEARS TO BE CRYSTALLINE BUT DOES NOT REACT WITH HCl. HORIZONTAL BANDS ~1 cm IN WIDTH ALTERNATE LIGHT AND DARK GRAY. FAULT WITH DOLOMITE CEMENT AT 253.6'. NUMEROUS FRACTURES HEALED WITH DOLOMITE CEMENT. POSSIBLE SOLUTION COLLAPSE BRECCIA AT 254.5'. DOLOMITE FILLS ALL PORES. NO MATRIX POROSITY OR PERMEABILITY	20°	S	N/A		FAULT POSSIBLE WATER PRODUCER
260–265	33	7 7 6 6 6	5.0	100	100	DARK GRAY GREEN SHALE - VERY WELL INDURATED WITH NO NATURAL PARTINGS OR FRACTURES. SURFACE TEXTURE LOOKS LIKE LIMESTONE BUT NO REACTION WITH HCl. POROSITY AND PERMEABILITY NEAR ZERO. SOME HORIZONTAL BANDING (LIGHT/DARK) VISIBLE. GRADUAL CHANGE IN COLOR FROM GREEN TO RED AT BASE	N/A	N/A	N/A		NO WATER PRODUCTION
						END OF BORING TD - 265'					

S = SLICKENSIDES

HART

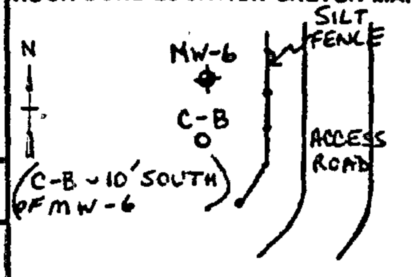
FRED C. HART ASSOCIATES, INC.

ROCK CORE LOG

BORING NO. C-B

PROJECT NO./NAME 01023 18 00009 03 / AT&T NASSAU	**LOCATION** FREELAND, PA.
HART GEOLOGIST/OFFICE S.F. URSCHEL / ALBANY	**START/FINISH DATE** 7/19 - 7/25 1988

ROCK CORE LOCATION SKETCH MAP



DRILLING CONTRACTOR PARATT - WOLFF	**DRILLING EQUIPMENT** MOBIL DRILL B-57	**DRILLER** BILL RICE	**CORE BIT SIZE** NX 3" OD
WATER SOURCE FREELAND WATER AUTHORITY	**WELL INSTALLED?** YES ☐ NO ☒	**T.D.-BOREHOLE** 255'	**NO. OF CORE RUNS**

THICKNESS AND TYPE OF OVERBURDEN 2.5' RED SILT, SAND, ROCK FRAGMENTS (WET FROM RAIN)

REMARKS:

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOG	REMARKS
0–10						CASING TO 10' RED COLORED WASH					BEDROCK @ 2.5'
10–20	1	5 4 3 5 5 5 8 4 4 2	6.1	64	6	SEVERELY WEATHERED RED SHALE: MOSTLY ROUNDED CLASTS WITH RARE 1-3" CORE CYLINDERS. NUMEROUS FRACTURES SHOWING MINERALIZATION ON SURFACES. SOLUTION ENLARGED VUGS AND PORES. SOME VUGS CONTAIN WEATHERED ROCK FRAGS AND CLAY. EXTREMELY WEATHERED DOLOMITE BLEBS. PERMEABILITY AND POROSITY HIGH. FINE WAVY LAMINAE IN MORE CONSOLIDATED ZONES.	0° TO 45°	W	0.1 TO 3"		

AR312924

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
25	2	5, 4, 5, 7, 7, 6, 9, 6, 4, 5	9.9'	99	46.7	RED SHALE - EXTREMELY WEATHERED HIGHLY FRACTURED. SOLUTION ENLARGED PORES AND VUGS. VERY FINE GRAINED CLAYSTONE THROUGHOUT. WAVY HORIZONTAL LAMINAE VISIBLE IN MANY AREAS. MUCH CLAY IN FRACTURES, MAYBE DRILL CUTTINGS. POROSITY & PERMEABILITY QUITE HIGH	0° TO 45° TO 90°	W W W	VARIABLE		
30 35	3	3, 4, 3, 3, 3, 4, 4, 5, 5, 8	10.0'	100	50.5	RED SHALE: MULTIPLE FRACTURES BOTH HORIZONTAL AND VERTICAL SPACING VARIES FROM 0.1" TO 10" ROCK PRIMARILY VERY FINE GRAINED (CLAYSTONE) WITH LESSER AMOUNTS OF SILTSTONE (~30%). FRACTURING HAS ENHANCED PERMEABILITY. MINOR AMOUNTS OF MICA SEEN IN SILTY INTERVALS. MICA FLAKES <0.25 mm.	0° TO 90°	W	VARIABLE		
40 45 50	4	6, 7, 6, 5, 8, 6, 5, 5, 6, 6	10.0'	100	92.5	RED-GRAY SILTSTONE: VERY HARD WELL INDURATED. WELL DEVELOPED HORIZONTAL LAMINAE, CROSS-LAMINAE IN PLACES; SLIGHTLY CALCAREOUS SILTSTONE INTERFINGERING WITH FINE RED CLAYSTONE IN SOME AREAS. SHARP CONTACT WITH RED CLAYSTONE AT 47.7' AND GRADES BACK TO SILTSTONE BY 48.2'. MANY HORIZONTAL AND VERTICAL FRACTURES. CLOSED MICROFRACTURES VISIBLE AT MANY DEPTHS. SOME OPEN FRACTURES (HORIZONTAL) INDICATE LOSS OF ROCK DUE TO DRILLING.	90° / 0° / 45°	C / C / C	N/A / N/A / 12"		

AR312925

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
50–60	5	5½, 5½, 6½, 8, 6, 5, 5, 5, 5, 5	10.0	100	92.5	GRAY-RED BANDED SILTSTONE WITH CALCITE CEMENT. PERCENTAGE OF CALCITE VARIES WITH DEPTH (NO TREND). 50.45' CALCAREOUS INTRACLASTS (RIP-UP CLASTS) INTERMIXED WITH SILTSTONE/CLAYSTONE MATRIX. 50.85' CORE REVERTS BACK TO RED SHALE WITH RARE CALCITE BLEBS. HORIZONTAL FRACTURES AT 51.0' RED SHALE WITH FINE CROSS LAMINAE CONTAINING SILT WITH MICA CRYSTALS. CALCAREOUS INTRACLASTS AT VARIOUS DEPTHS, FRACTURES PARALLEL TO BEDDING (HORIZONTAL) AT 52.0'. CALCITE BLEBS INCREASE IN NUMBER, CONCENTRATION AND SIZE TOWARD BASE OF RUN.	0° 45° 0° ~0°	W W W W	N/A N/A 0.25 N/A		FRACTURES CALCITIC INTRACLASTS
60–70	6	7, 6, 5, 5, 8, 6, 6, 6, 6, 5	10.0	100	100	RED SHALE (MASSIVE CLAYSTONE) VERY WELL INDURATED, NO VISIBLE ALLOCHEMS IN SHALE MATRIX. RARE CALCITE BLEBS OFTEN SUGGESTIVE OF REPLACED EVAPORITES RARELY APPEAR LIKE FOSSIL TEST OR OOIDS. VERTICAL TRAIN OF BLEBS NEAR BASE OF RUN SUGGESTIVE OF BURROW FILLING. ORIGIN UNKNOWN. ROCK IS TIGHT WITH NO NATURAL FRACTURES. FINE MICA GRAINS VISIBLE THROUGHOUT.	N/A	N/A	N/A		
70–80	7	6, 8, 6, 5, 6, 6, 5, 8, 5¾, 6	10.0	100	100	RED SHALE (MASSIVE CLAYSTONE) WELL INDURATED WITH SPARSE CALCITE AND DOLOMITE BLEBS. FAINT WISPY LAMINAE. NATURAL FRACTURES AT 71.45', 73.31', 75.0–76.0' (VERTICAL), 76.6', 76.8' (HORIZONTAL TO 45°)	0° TO 45°	C	0.2'		

AR312926

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
80–90	8	6, 6, 5, 5, 7, 5, 6, 7, 6, 7	10.05	100.5	100	RED SHALE: (MASSIVE CLAYSTONE) SCATTERED CALCITE BLEBS, RARE DOLOMITE BLEBS, FAINT MOTTLED TEXTURE. WELL INDURATED WITH FAINT WAVY LAMINAE. LARGE VERTICAL FRACTURE AT 87.0', ALSO CROSS BEDDING VISIBLE AT THIS DEPTH. CARBONATE CEMENT FROM 87.0' TO BASE OF RUN. FINE MICA FLAKES (SERICITE) SEEN THROUGHOUT CORE	70° TO 90°	C	N/A		
90–100	9	5, 6, 7, 7, 10, 6, 7, 10, 8, 8	10.0	100	95.5	RED SHALE WITH CALCITE BLEBS WELL INDURATED. NATURAL NEAR VERTICAL FRACTURE AT 92.4' CORE DISPLAYS HORIZONTAL BANDING, CROSS-BEDDED REGIONS WITH CALCAREOUS CEMENT. FAULT WITH SLICKENSIDE STRIAE AT 98.2'.					FAULT- ONLY LIKELY WATER PRODUCER IN THIS RUN
100–110	10	9, 10, 9, 10, 9, 10, 8, 7, 5, 9	10.0	100	98	RED SHALE WITH CALCITE BLEBS. FAINT HORIZONTAL LAMINAE. OBLIQUE FRACTURE AT 102.0'. CROSS LAMINAE AND FINE DOLOMITE CEMENT FILLING ALONG BEDDING PLANES. CROSS-LAMINAE RESULT FROM SILT/CLAY MIXTURE. SLIGHTLY SILTY TEXTURE WHICH REACTS WEAKLY WITH HCl. SEDIMENT FILLED MICROFRACTURE (VERTICAL) POSSIBLE BURROW FILLED WITH CROSS-LAMINATED SEDIMENT (CALCAREOUS). HORIZONTAL FRACTURES AT 107.9 AND 108.1' WAVY CROSS LAMINAE WITH CALCITE CEMENT TO BASE OF RUN	45°; 0°	C; C	N/A; 0.1'		

AR312927

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	ANGLE	COND.	SPACING	REMARKS
110–120	11	7, 5, 7, 6, 6, 7, 8, 9, 9½, 14	10.0	100	99.6	RED SILTY SHALE - FAINT HORIZONTAL LAMINAE, GRAYISH REGIONS CONTAIN CALCITE CEMENT. FRACTURE AT 112.9' WITH CALCITE MINERALIZATION. CROSS LAMINAE THROUGHOUT RUN WITH FINE MICA FLAKES AS WELL. FRACTURES (LOW-ANGLE) AT ~114.5', 114.75', 115.6', 117.0', 117.4', 118.7', 119.35'.	80° 0° 0° TO 45°	C Ca C Ca	N/A	
120–125	12	10, 16, 12, 13, 14	5.0	100	83	RED CROSS LAMINATED SILTSTONE WITH INTERMITTENT CLAY LAYERS. SILTY LAYERS ARE SLIGHTLY CALCAREOUS. SEVERAL DISTINCT ZONES DISPLAYING CALCITE BLEBS, MANY ARE ELONGATED PARALLEL TO BEDDING, OTHERS ARE NODULAR. FRACTURES AT 120.3', 123.37', 123.67', 124.8'	0° 0°	W C	N/A 3" TO 2'	WEATHERED FRACTURE
125–135	13	8, 10, 7, 6, 8, 6, 6, 5, 6, 5	10.0	100	98	RED SHALY-SILTY WACKESTONE WITH NUMEROUS CALCITE INTRACLASTS FROM 125.35 TO 126.65'. LAMINATED RED SHALE, SLIGHTLY CALCAREOUS TO BASE OF RUN.	0° 0°	C Cl	N/A N/A	CLOSED FRACTURE MAYBE DB
135–140	14	N/A	4.9	98	100	LAMINATED MASSIVE SHALE - SLIGHTLY CALCAREOUS NUMEROUS CALCITE BLEBS AT 136'. BLEBS AS LARGE AS 2 cm IN LENGTH. LONG DIMENSION PARALLEL TO BEDDING NATURAL FRACTURE AT 136.75'	0°	C	N/A	NATURAL FRACTURE

C - CLEAN
Ca - CALCITE MINERALIZATION
Cl - CLOSED FRACTURE

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	ROD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
140–150	15	5, 6, 7, 6, 6, 6, 6, 5, 4, 5, 6	10.05'	100.5	100	RED CRYSTALLINE CARBONATE WITH INTERSPERSED SHALE. MATRIX COMPOSED OF DARK CALCITE AND CLAYSTONE BLEBS AND INTERFINGERING BEDS. HARD WITH MICA FLAKES. CARBONATE PERCENTAGE VARIES THROUGHOUT RUN. CORE VARIES FROM > 50% CARBONATE TO < 10%. VERY WELL INDURATED WITH ONLY ONE NATURAL FRACTURE AT 142.4' VERY FINE MICA FLAKES THROUGHOUT. PROBABLY METAMORPHOSED AT LOW TEMPERATURES AND PRESSURES	0°	C	N/A		
150–160	16	4, 6, 5, 7, 9, 6, 5, 5, 4, 6	10.0	100	100	RED SHALY CARBONATE: WITH WAVY HORIZONTAL LAMINAE ALTERNATING SHALE/CARBONATE. WELL INDURATED WITH NATURAL FRACTURES AT 152.9, 154.16, 154.16 – 155.85 (VERTICAL), 155.85 (HORIZONTAL), 158.91'. SHALY ZONES SHOW WAVY BEDDING AND SMALL (< 1.0 mm) INTRACLASTS. ROCK IS WELL INDURATED WITH FINE MICA FLAKES					POSSIBLE WATER PRODUCING ZONE
160–170	17	6, 6½, 7, 7, 7, 6, 6, 6, 7, 6	10.0	100	93.6	FINELY LAMINATED SHALE – NON-CALCAREOUS WITH WAVY OBLIQUE CLAY BEDS. EVIDENCE OF SOFT SEDIMENT DEFORMATION, FRACTURING AND FILLING. NATURAL VERTICAL FRACTURE AT 163.5' TO 163.8'. HORIZONTAL AND VERTICAL FRACTURE AT 165.9 TO 167.0'. SHALE BECOMES CALCAREOUS AND CROSS-BEDDED AT 167.4'. SHARP CONTACT WITH CARBONATE WACKESTONE TO PACKSTONE AT 167.5'. NUMEROUS HORIZONTAL FRACTURES FROM 167.65' TO 168.35'. IRON AND POSSIBLE SULFIDE MINERALIZATION OF FRACTURE SURFACES.	0° to 90°; 0°	W; W			LIKELY WATER PRODUCING ZONE

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
170–180 (175)	18	6, 4, 5, 5, 6, 5, 3, 5, 4, 6	10.0	100	100	HARD LAMINATED RED SHALY CARBONATE WELL DEVELOPED HORIZONTAL TO SLIGHTLY OBLIQUE LAMINAE. WELL INDURATED WITH MICA FLAKES THROUGHOUT. BEGINNING AT 174.4' AND CONTINUING TO 176.31'. ROCK IS GRAY-RED CARBONATE WITH MICA. NATURAL FRACTURE AT 171.05', 179.36', 179.65'. CROSS BEDDING VISIBLE AT 179.25'.	0°	C	N/A		
180–190 (185)	19	5, 8, 6, 4, 6, 5, 5, 5, 4, 5	10.0	100	99	HARD, MASSIVE RED SHALE/SILTSTONE SLIGHTLY CALCAREOUS. CORE CONTINUES TO BASE OF RUN WITHOUT CHANGE WITH EXCEPTION OF MINOR SILTY LENSES SHOWING WAVY LAMINAE. TWO NATURAL HORIZONTAL FRACTURES OCCUR AT 189.12' AND 189.22'	0°	C	3"		
190–200 (195)	20	6, 6, 4, 3, 4, 5, 5, 5, 5, 4	10.0	100	100	GRAY-RED MASSIVE CLAYSTONE/CARBONATE MIXTURE, PERCENTAGE OF CALCITE IN MATRIX (AS CEMENT) VARIES THROUGHOUT RUN 20. WHERE CALCITE DOMINATES CORE IS GRAY WHERE CLAY DOMINATES CORE IS RED. FINE MICA FLAKES CAN BE FOUND THROUGHOUT CORE. CORE IS VERY HARD, WELL INDURATED AND FRACTURES APPEAR TO BE DRILLING BREAKS ONLY POROSITY AND PERMEABILITY NEAR ZERO RIP-UP CLASTS (CLAY) IN CARBONATE MATRIX AT 196.0'	0° / N/A	C / N/A	1" / N/A		POSSIBLE WATER- NO WATER ZONES

AR312930

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
200–210	21	4, 6, 5, 6, 7, 8, 11, 7, 7, 9	10.0	100	99.9	RED CLAYSTONE WITH VARYING AMOUNTS OF CARBONATE CEMENT. CROSS-BEDDING AND WAVY LAMINAE VISIBLE IN PLACES. RARE CLAY BLEBS. NATURAL FRACTURES AT 204.4', 205.57' WITH RUBBLE, 206.0', 206.9', 207.57', 208.3' AND 209.4'	0° 0°	C C	N/A 6"		RUBBLE
210–220	22	7, 7, 6, 7, 7, 9, 9, 13, 11, 8	9.9	99	100	WELL INDURATED RED CLAYSTONE A FEW LAMINAE CONTAINING SILT OR CARBONATE PARTICLES. CROSS-LAMINAE WITH CALCITE CEMENT IN PLACES. CALCITE BLEBS (INTRACLASTS). NATURAL FRACTURES AT 215.2', 216.0' TO 217.0' (VERTICAL), 217.6', 218.4' NUMEROUS LARGE CALCITE BLEBS AT ~218.0'. FINE MICA THROUGHOUT	0° 90° 0°	C C C	N/A		
220–221	23	9	1.0'	100	100	WELL INDURATED RED SHALE WITH CALCITE BLEBS	N/A	N/A	N/A		
221–230	24	5, 3, 4, 4, 2, 4, 6, 7, 7	9.0	100	100	WELL INDURATED RED SHALE (CLAYSTONE) MASSIVE WITH OCCASIONAL CALCITE AND RARE CLAY BLEBS. NO NATURAL FRACTURES. ZONES WITHIN CORE WHICH ARE RICH IS CALCITE CEMENT AND OFTEN SHOW CROSS-LAMINAE. CALCITE BLEBS OFTEN OCCUR WITH LONG DIMENSION PARALLEL TO BEDDING.	N/A	N/A	N/A		

AR312931

HART

FRED C. HART ASSOCIATES, INC.

BORING NO. C-B

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
230–240	25	6 6 5 5 5 4 4 5 4 4	10.0	100	100	MASSIVE RED CLAYSTONE WITH BLUE-GRAY CLAY BLEBS ELONGATED PARALLEL TO BEDDING. NATURAL FRACTURES AT 231.85', 234.2', 235.2', 236.0' AND 239.5'. CORE BECOMES SLIGHTLY SILTY AT 237.0'. THERE IS A DISTINCT LITHOLOGY CHANGE AT 239.5' WHERE THE FRACTURE OCCURS. ABOVE SILTY CLAYSTONE, BELOW FINE TO MEDIUM GRAINED SILTSTONE WITH UP TO 30% BIOTITE FLAKES. VERY HARD. CLAYS ALSO HIGH PERCENTAGE POSSIBLY UP TO 40% WITH CLEAR TO PINK CRYSTALS FORMING REST OF MATRIX POSSIBLY PLAGIOCLASE FELDSPAR	0° 0° 0°	C C C	N/A N/A N/A		RECOMMEND THIN SECTIONS OF THIS FACIES 239.5' POSSIBLE WATER PRODUCER
240–250	26	4 4 4 6 8 8 7 5 8 11	10.0	100	100	FINE TO MEDIUM GRAINED SILTSTONE GRADING TO COARSE GRAINED SANDSTONE WITH CLAYSTONE INTERBEDS. HORIZONTAL AND OBLIQUE BEDDING WITH WELL ROUNDED QUARTZ GRAINS AND CLAY RIP-UP CLASTS. OFTEN SHARP CONTACT BETWEEN CLAY (RED) AND SANDSTONE (GREEN-BLUE GRAY). SANDSTONE HAS AREAS WITH CALCITE CEMENT. COARSE CLASTS INCLUDE QUARTZ PEBBLES AND CLAY INTRACLASTS ALL WELL ROUNDED. NO NATURAL FRACTURES. COARSE MICA FLAKES THROUGHOUT AND POSSIBLE GLAUCONITE (OLIVE GREEN GRAINS)	N/A	N/A	N/A		NO NATURAL FRACTURES ZERO POROSITY ZERO PERMEABILITY
250–255	27	6 9 11 7 6	5.0	100	100	SANDSTONE (BLUE-GRAY) CONTINUES TO 252.6'. FRACTURES AT 252.6' SEPARATES SANDSTONE ABOVE FROM RED SHALE BELOW. NATURAL FRACTURES AT 253.67' AND 254.54'					RUBBLE
255–260						END OF BORING C-B					

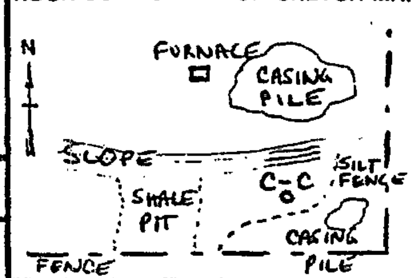
AR312932

HART

FRED C. HART ASSOCIATES, INC.

ROCK CORE LOG

ROCK CORE LOCATION SKETCH MAP



BORING NO. C-C

PROJECT NO./NAME	LOCATION
01023 18 0000903 / AT+T NASSAU	C+D RECYCLING

HART GEOLOGIST/OFFICE	START/FINISH DATE
S. UESCHEL & H HATFIELD / ALBANY	7/14 - 7/18 1988

DRILLING CONTRACTOR	DRILLING EQUIPMENT	DRILLER	CORE BIT SIZE
PARATT - WOLFF	MOBILE DRILL-B57	BILL RICE	NX (3" OD)

WATER SOURCE	WELL INSTALLED?	T.D.-BOREHOLE	NO. OF CORE RUNS
FREELAND WATER AUTHORITY	YES ☐ NO ☒	200 FT	20

THICKNESS AND TYPE OF OVERBURDEN

REMARKS: ARTESIAN FLOW

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOG	REMARKS
0–10						CASING					WATER FLUSHED DEEP RED COLORED CLAY AND SILT PARTICLES
10						CORING BEGINS					
10–20	1	6 3½ 3 7 4 3 6 5½ 5 4	9.5	95	55	SHALE: RED, NUMEROUS NATURAL PARTINGS TO 1.9' MINOR SOLUTION POROSITY PERMEABILITY NEAR ZERO WITHOUT FRACTURE ENHANCEMENT. VERTICAL FRACTURE AT 2.4', 5.1', 7.0', 8.0'. SHALE SHOWS VERY MINOR SECONDARY SOLUTION ENHANCED POROSITY	0° TO 90°	W	1" TO 1'		

W = WEATHERED

AR312933

FRED C. HART ASSOCIATES, INC.

BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
20–30 (25)	2	4, 4, 4, 4, 4, 4½, 4, 4, 4, 4½	10	100	69	SHALE: RED, FAIRLY WELL INDURATED HOWEVER THERE ARE NUMEROUS OBLIQUE FRACTURES (<20°) THROUGHOUT. MODERATE SOLUTION ENHANCED SECONDARY POROSITY INCLUDING VUGS UP TO 25cm IN DIAMETER. ? NATURAL VERTICAL FRACTURES ARE PRESENT THROUGHOUT CORE. SHALE SHOWS EXTREMELY MOTTLED APPEARANCE FROM 22' TO 25' POSSIBLY BURROW MOTTLED. HEAVY DISSOLUTION AT 28.2'. SOLUTION ENLARGED SECONDARY PORES POSSIBLY DUE TO CARBONATE DISSOLUTION 28.8'-29.6' DOLOMITE/SHALE WITH SOLUTION PORES.	<20°	W	1" TO 1'		COUNTED 30 OBLIQUE FRACTURES WITH < 20° ANGLE TO HORIZONTAL. POSSIBLE WATER ZONE
30–40 (35)	3	3½, 5½, 3½, 3½, 3, 2, 2½, 2, 3, 2½	9.9	99	68	RED SHALE NUMEROUS NEAR HORIZONTAL FRACTURES, FINE WISPY LAMINAE, NO OBVIOUS CLASTS OR ALLOCHEMS OF ANY KIND. HIGH ANGLE FRACTURE AT 39.5'. MINOR WISPY DOLOMITE LENSES	<20°; <20°; ~80°	W TO SW; W TO SW; W	<1" TO >10"		
40–50 (45)	4	2, 2, 3, 2½, 3, 2½, 2½, 2, 2½, 2½	10.0	100	92	SHALE: RED, FINE WISPY LAMINAE HORIZONTAL PARTINGS AT SPACING OF 4" TO 10". WISPY LAMINAE IN SHALE AT 41.6' TO 42.3' SURROUND LIGHT GRAY COLORED BLEBS SUGGESTIVE OF EVAPORITE NODULES. SLIGHTLY SILTY AT 41.7'. WELL DEVELOPED VUGGY POROSITY 44.0' AS A RESULT OF DISSOLUTION OF NODULES DISCUSSED ABOVE. BLUE-GRAY CRYSTALLINE DOLOMITE BLEBS 45' TO 50'. SIZES RANGE FROM A FEW mm TO 10's OF mm. DOLOMITE SHALE CONTACT AND BLEB MORPHOLOGY SUGGEST DISSOLUTION-REPLACEMENT. NO ALLOCHEMS VISIBLE.	0°	SW	4" TO 10"		

W = WEATHERED
SW = SLIGHTLY WEATHERED

FRED C. HART ASSOCIATES, INC.

BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	GRAPHIC LOC.	REMARKS
50–60	5	2, 2½, 3½, 2, 3, 3, 3½, 4, 4, 3½	10.0	100	90	RED SHALE WITH SPARSE DOLOMITE BLEBS AND COMMON FINE WISPY LAMINAE NUMEROUS FRACTURES (HORIZONTAL) FROM 56.0' TO 57.6' - PROBABLE WATER ZONE SOME FRACTURING BELOW MINOR NEAR VERTICAL FRACTURES	0°	SW	½" TO 2"		PROBABLE WATER ZONE AT 56.0'-57.5'
60–70	6	5, 3, 5, 2, 3, 2½, 3, 3, 2½, 3	9.9	99	83	RED SHALE WITH FINE WISPY LAMINAE, LARGE VERTICAL FRACTURE AT 61.0'. DIRECTLY OVER A SILTY CRYSTALLINE DOLOMITE BED ~6" THICK REMAINDER CONTINUES AS RED SHALE WITH LAMINAE. NO VISIBLE ALLOCHEMS 9 HORIZONTAL FRACTURES 1 VERTICAL	0° 80°-90°	C C TO SW	AVG 6"		
70–75	7	2½, 2½, 3½, 3, 3½	5.0	100	75	RED SHALE - FINE LAMINAE OCCASIONALLY WITH MINOR CRYSTALLINE DOLOMITE BLEBS ON BEDDING PLANE NO VISIBLE ALLOCHEMS. FRACTURING HORIZONTAL PERMEABILITY PROBABLY LOW EXCEPT IN FRACTURES	0°	C	AVG 10"		
75–80	8	3, 4, 4, 4, 4	5.0	100		RED SHALE, WELL LITHIFIED, NO VISIBLE ALLOCHEMS. THIN DOLOMITE TRACE PARALLEL TO BEDDING AT 75.9' MOTTLED APPEARANCE THROUGHOUT, SLIGHTLY SILTY. FRACTURES AT 45° AND 0° TO HORIZONTAL.	0° TO 45°	C TO SW	8"		

AR312935

FRED C. HART ASSOCIATES, INC.

BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
80–90	9	3½, 2, 2½, 2½, 3, 2½, 2½, 3, 2½, 5	10.0	100	100	RED SHALE - VERY WELL LITHIFIED MOTTLED THROUGHOUT NUMEROUS BLEBS ~1.0 mm IN LENGTH CONTAINING CALCITE. POSSIBLY FOSSILS, BURROWS OR EVAPORITE MOLDS. POSSIBLE RIP-UP CLASTS AT 85.6-85.7' (FINE BLUE-GRAY DOLOMITE STREAK) FINE WISPY LAMINAE NEAR VERTICAL FRACTURE CONTAINS CALCITE CEMENT - STILL PARTLY OPEN	80°	SW	N/A		85' CALCITE BLEBS
90–100	10	4, 3, 3, 4, 3½, 2½, 3, 3½, 3, 4	10.0	100	100	MOTTLED RED SHALE WISPY LAMINAE, CALCITE DOLOMITE FILLED FRACTURES NUMEROUS BLEBS CONTAINING DOLOMITE WHICH RESEMBLE EVAPORITE NODULES AND SUGGEST AN UPPER-INTERTIDAL TO SUPRA-TIDAL DEPOSITIONAL SETTING. MANY FILLED FRACTURES (BURROWS?) SLIGHTLY SILTY POSSIBLY SILICEOUS INTERVAL AT 92.3' TO 94.3' AND GRADES BACK TO MOTTLED SHALE. TWO NEARLY HORIZONTAL FRACTURES SHOWING WEATHERED, MINERALIZED SURFACES PARALLEL TO LAMINAE	0°	C TO SW	3'		
100–110	11	3, 3½, 3, 3, 3, 3, 2½, 3, 3, 3½	9.95	99	100	RED SHALE - WELL LITHIFIED, FINE WISPY LAMINAE WITH OCCASIONAL BLUE-GRAY DOLOMITE 7 NATURAL FRACTURES 5 HORIZONTAL 2 80-90°	0° TO 80°	C TO SW	4" TO 2'		

C = CLEAN
SW = SLIGHTLY WEATHERED
W = WEATHERED

AR312936

FRED C. HART ASSOCIATES, INC.

BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	GRAPHIC LOC.	REMARKS
110–120	12	2, 3, 5, 5½, 8½, 4, 5, 5, 5, 6	9.9	99	77	RED SILTY SHALE TO SILTSTONE INTERSPERSED WITH BLUE-GRAY DOLOMITE VERY SILTY (DOLOMITIC) AT 111.0' FLAMMÉ STRUCTURES VISIBLE. FINE WISPY LAMINAE THROUGHOUT. EXCELLENT FRACTURING, HIGH PERMEABILITY AND POROSITY AT 117.0' LIKELY WATER ZONE. ROCK MORE COMPETENT BELOW 117.8'	0° TO 45°	SW TO W	1" TO 12"		WATER LOSS AT 110.5'. TURNED UP WATER VOLUME AT 117'. PARTIAL WATER RETURN
120–130	13	4, 1, 6, 4, 5, 4, 4, 5, 4, 4	9.85	98	100	RED SHALE, WELL LITHIFIED, SHOWING FINE LAMINAE, AND NUMEROUS CALCITE BLEBS WITH MORPHOLOGIES RESEMBLING SMALL EVAPORITE NODULES. CALCITE BLEBS RANGE IN SIZE FROM 0.1 - 120 mm. EXTREMELY WELL DEVELOPED WAVY LAMINAE BELOW 126.0'. MORPHOLOGY SUGGESTS ALGAL LAMINAE, ALTERNATING LAYERS CONSIST OF FINE SILT (CALCITIC) AND RED CLAY. NO FOSSILS VISIBLE. POSSIBLY UPPER-INTERTIDAL TO SUPRATIDAL DEPOSITION WITH CALCITIC REPLACEMENT OF ANHYDRITE NODULES AND STROMATOLITE GROWTH.	N/A	N/A	N/A		DRILLERS BREAKS ONLY. NO NATURAL FRACTURES
130–140	14	3½, 4, 4, 3, 4, 3½, 4½, 5, 4½, 6	9.90	99	100	RED SHALE, SOMEWHAT SILTY, PARTLY MOTTLED, ALGAL(?) LAMINAE AND DOLOMITE/CALCITE BLEBS AT 136.0'. ONLY DRILLERS BREAKS, NO NATURAL FRACTURES, VERY WELL LITHIFIED. NO ALLOCHEMS OR CLASTS VISIBLE.	N/A	N/A	N/A		

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FRED C. HART ASSOCIATES, INC.

BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
140–150	15	4, 4½, 4½, 3½, 4, 3½, 3½, 4, 4½, 3½	9.7	97	100	RED SHALE showing minor silt and numerous calcite blebs. Calcite mostly likely replaces anhydrite nodules. No visible structures or laminae. Drillers breaks only; no natural fractures. Very competent rock. Thin dolomite streak at 142.5' (~1-2 mm in width). Dolomite (blue-gray color) bleb at 144.0' with morphology similar to burrow	N/A	N/A	N/A		
150–160	16	4, 4, 4½, 5, 5, 4, 4½, 5, 4, 8	10.15	>100	100	RED SHALE with minor silt and numerous calcite blebs. Calcite blebs appear to resemble foraminifera tests but no internal structure is visible due to crystal growth. Wispy laminae present at 155.0'. No natural fractures, only drillers breaks. Calcite blebs range in size from 0.1 mm to 1 cm.	N/A	N/A	N/A		CORE BLOCK @ 159.5'
160–170	17	5, 5, 5, 3, 3½, 4, 6, 7, 4, 2½	10.0	100		RED SHALE with minor silt. Numerous calcite blebs. Near vertical fracture. Dolomite blebs ranging in size from 5-25 mm and scattered randomly throughout core. No evidence of dissolution.	80° to 60°	C	N/A		

AR312938

FRED C. HART ASSOCIATES, INC.

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BORING NO. C-C

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD (%)	ROCK CORE DESCRIPTION	CRACKS: ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
170–180	18	5, 4, 3½, 4½, 4½, 6½, 4½, 4½, 3½, 3	10.0	100	100	RED SHALE, WELL LITHIFIED CALCITE FILLED FRACTURE AT 171.5'. NUMEROUS CALCITE BLEBS. CALCITE INTRACLASTS AT 176.8', UP TO 2.5 cm IN DIAMETER. WAVY HORIZONTAL LAMINAE SUGGESTIVE OF ALGAL LAMINAE. POROSITY AND PERMEABILITY NEAR ZERO	0°	CC	N/A		ARTESIAN FLOW ↓
180–190	19	3, 4½, 5, 4½, 3, 3, 5, 5, 4, 5	10.1	101	100	RED SHALE, WELL LITHIFIED, SHOWING BURROW MOTTLING TO 181.5'. FRACTURES POSSIBLY PRODUCED BY SOFT-SEDIMENT DEFORMATION, NOW FILLED WITH SILT AND CLAY. WAVY LAMINAE THROUGHOUT OFTEN SHOWING EFFECTS OF DEWATERING OF SOFT-SEDIMENT. NUMEROUS CALCITE BLEBS (POSSIBLY FOSSIL TESTS) SILTY, WELL LAMINATED, NO POROSITY AT 186.9'. THIN DOLOMITE HORIZON (1 mm THICK) AT 187.2'. SHALE CONTINUES TO 189.9'	0°	C	N/A		
190–200	20	4, 4, 6, 8, 6, 3, 4, 4, 4, 4	10.1	101	100	RED SHALE - DARK MOTTLING, SUGGESTIVE OF BURROW MOTTLING. CLOUDY BANDING LIGHT AND DARK SHADES OF DEEP RED. CALCITE BLEBS AT 195.0' PROBABLY AS REPLACEMENT FOR ANHYDRITE. 195.6' VERTICAL FRACTURE WHICH WAS PRESENT BUT CLOSED UNTIL DRILLING. ADDITIONAL CALCITE BLEBS AND MOTTLING	90°	C	N/A		4:37 pm WATER LEVEL 25' ABOVE GROUND LEVEL IN DRILL PIPE

C = CLEAN
CC = CALCITE CEMENT

AR312939

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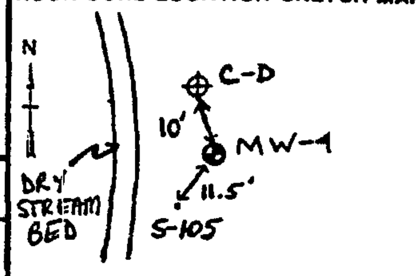
ROCK CORE LOG

ROCK CORE LOCATION SKETCH MAP



BORING NO.	C-D
PROJECT NO./NAME	01023 18 00009 03 / AT-T-NASSAU
LOCATION	C-D RECYCLING FREELAND, PA
HART GEOLOGIST/OFFICE	H. HATFIELD & S. URSCHEL / ALBANY
START/FINISH DATE	7/12-7/13 1988
DRILLING CONTRACTOR	PARATT-WOLFF
DRILLING EQUIPMENT	MOBILE DRILL B57
DRILLER	BILL RICE
CORE BIT SIZE	NX (3" OD)
WATER SOURCE	FREELAND WATER AUTHORITY
WELL INSTALLED?	YES ☐ NO ☒
T.D.-BOREHOLE	60.0'
NO. OF CORE RUNS	8
THICKNESS AND TYPE OF OVERBURDEN	6.0' SILTY SAND REDDISH BROWN
REMARKS:	SHARP CONTACT WITH SILTY BLUE GRAY DOLOMITE @ ~42'

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT)	% RECOVERY	RQD	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOG	REMARKS
5											
	1	6½, 7½	2.0'	100	0	SANDSTONE: GREENISH-BROWN, MED TO FINE GRAINED; MICACEOUS, MODERATELY HARD; DARK IRON STAINING AT FRACTURES; NUMEROUS FRACTURES. 10.0'	0°	W	3"		WASH WATER LIGHT TAN; 7 HORIZ. FRACTURES; 3 OBLIQUE (~45°)
10	2	5, 6½	2.4'	100	31	SANDSTONE: SAME AS ABOVE TO 12.0'; 12.0-12.4' COARSE GRAINED, LARGE (¼") QUARTZ CLASTS 12.4'	0°	W	3-4		13 HORIZ. FRACTURES; 2 VERTICAL
	3	7	1.0	100	0	SANDSTONE: GRN-BR, COARSE GRAINED, MOD. HARD, DK IRON STAINING @ FRAC; NUMEROUS FRAC 13.4'	0°	W	2		WATERLOSS 12.8-13.2'; 8 HORIZ. FRACTURES.
15	4	3, 6½, 6, 5½, 5, 2½, 1½	6.1	92	42	SILTSTONE: TAN TO LIGHT BR.; MOD. HARD; BK STAINING @ FRAC; NUMEROUS FRAC 15.1'	0°	W	2		10 HORIZ. FRACTURES; WATERLOSS 18.0-20.0'
						SILTSTONE-DOLOMITE TRANSITION; BR TO BLUE GRAY; FINE GRAINED, REHEALED FRAC (WITH SILTSTONE); MOD. HARD; DK STAINING AT FRAC; NUMEROUS FRAC 16.7'	0°	W	2-3		4 HORIZ. FRACTURES; 1 OBLIQUE (45°) FRAC
						DOLOMITE: BLUE-GRAY, FINE TO MED. GRAINED; FEW FRACTURES; DK IRON STAINS AT FRACTURES	0°	W	12		5 HORIZ. FRACTURES

W = WEATHERED

AR312940

FRED C. HART ASSOCIATES, INC.

BORING NO. C-D

DEPTH	RUN NO.	CORE TIME (MINS)	RECOVERY (FT.)	% RECOVERY	RQD	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOC.	REMARKS
25, 30	5	4, 13, 8, 5, 5, 6, 5, 4½, 4½, 4	9.95	99	72	DOLOMITE: BLUE-GRAY, FINE TO MED CRYSTALS, MILKY WHITE ~2 mm CALCITE PLEBS GRADING TO RED SHALE FROM 20' TO 20.6'. SOLUTION DERIVED SECONDARY POROSITY IN DOLOMITE (2-5mm) AT 20.6' RED SHALE; WELL CEMENTED NON-FISSILE AT 24.6' CARBONATE PLEBS (1-5mm) IN SHALE. WISPY LAMINAE IN SHALE AT 27.5' WISPY GRAY-BLUE DOLOMITE LAMINAE AT 27.9' SOLUTION DERIVED SECONDARY POROSITY ALONG WITH DOLOMITE LAMINAE. MOLDIC POROSITY, POSSIBLY BURROW MOTTLED.	0°	W	2"		NO WATER RETURN IN RUN 5 7 HORIZ FRACTURES
35, 40	6	7, 7, 4, 4, 4½, 7, 5, 3½, 5, 4½	10.1	101	100	RED SHALE WITH FINE WISPY LAMINAE DOLOMITE LAMINAE AT 37.0'. CALCITE FILLED BLEBS AT 38.0'. DOLOMITE LAMINAE CALCITE BLEBS, POSSIBLY FILLED BURROWS (2-10 mm IN LENGTH)	0°	C	4" TO 8"		
45	7	7½, 5½, 5, 4, 4, 3, 2½, 2, 2, 2	9.9	99	92	RED SHALE WITH FINE WISPY LAMINAE INCLUDING DOLOMITE (BLUE-GRAY) LAMINAE BLUE-GRAY DOLOMITE - PERVASIVE DOLOMITIZATION FINE TO MEDIUM CRYSTALLINE, NO OBVIOUS ALLOCHEMS. CONTINUOUS DOLOMITE TO 49.9' POROSITY (0%), PERMEABILITY ZERO, BASED ON VISUAL OBSERVATION FINE MICA FLAKES THROUGHOUT SLIGHTLY SILTY	0°	W	1" TO 3"		NO WATER RETURN ↓ TO 50.0'

W = WEATHERED
C = CLEAN (PROBABLE DRILLERS BREAK)

AR312941

FRED C. HART ASSOCIATES, INC.

BORING NO. C-D

DEPTH	RUN NO.	CORE TIME	RECOVERY	% RECOVERY	RQD	ROCK CORE DESCRIPTION	CRACKS ANGLE	COND.	SPACING	GRAPHIC LOC.	REMARKS
		2.5				BLUE-GRAY CRYSTALLINE DOLOMITE PERVASIVE DOLOMITIZATION WITH NO VISIBLE ALLOCHEMS. MEDIUM TO FINE CRYSTAL SIZE MICA FLAKES MINOR MINERALIZATION ON TWO NATURAL FRACTURES VERY WELL INDURATED, SLIGHTLY SILTY.					
		3									
		2.5									
		2.5									
55	8	2.5	10	100	100		45°	SW	2'		
		4.0									
		3.0									
		2.5									
		4.5									
60		4.0				END OF BORING C-D 60.0'					

AR312942

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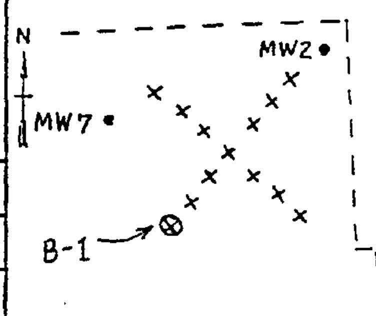
FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH MAP



BORING NO.	B-1
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / D.J. Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" roller bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DATE	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-1 0-2	1.2	3, 5, 7, 4	Red clay and silt, some gravel (bedrock frags) Top 0.2 Ft: brown topsoil and organic material, clay rich, moist	Gravel: subang. dry		
3	B-1 2-4	1.4	3, 4, 8, 17	Clay, silt, + gravel. Bedrock is weathered, red, and moist. More frags than above, subangular.	Bedrock Frags. of red shale + siltstone		
5	B-1 4-6	1.3	19, 21, 23, 30	Weathered bedrock as above, dry, less clay, more silt, larger frags			
7	B-1 6-8	1.4	13, 19, 50/3"	Weathered bedrock - Red brown clay and silt with shale + siltstone frags, dry to moist	Cuttings: dry shale + siltstone frags.		
9		0	50/0"	No recovery. Drill cuttings: weathered bedrock. Siltstone and shale	Increase in dust. Added water.		
10, 11							
15				EOB 12.5 Ft Rock ~9 Ft at spoon refusal. Rock hardness did not change over last 3.5 Ft. Cuttings: siltstone and shale			

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

AR312943

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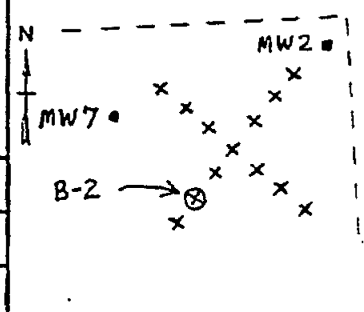
FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH M



BORING NO.	B-2
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller bit
SAMPLING METHOD	2" Split spoon
START/FINISH DAT	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-2 0-2	1.8	2, 3, 9, 7	Top 0.5 Ft: Red brown topsoil with organics + gravel. 0.5-1.8: Red clay, silt, and gravel (F-m) Weathered bedrock dry-moist, red	Rock Frags larger and siltier with depth		
3	B-2 2-4	1.6	9, 7, 6, 8	Red, moist weathered siltstone and shale with clay and silt	Drilled to 3 Ft. Then began adding water.		
5	B-2 4-6	1.7	10, 13, 13, 16	Same as above - more clay, some brown areas, larger rock Frags.			
7	B-2 6-8	0.8	12, 16, 50/1"	Same as above - Red clay and shale Frags. Some silt and siltstone.	No moisture content analysis due to added water.		
9	B-2 8-10	1.0	50, 20, 15, 21	Red weathered shale and siltstone, more competent than above.			
10, 11	B-2 10-12	0.6	22, 50/3"	Red soft to med. shale, slightly weathered, clayey, little silt			
13		0	50/0"	No recovery. Drill cuttings: shale + siltstone. More siltstone with depth.	Becomes harder at 12 Ft.		
15				EOB 14 Ft Rock @ 12 Ft.			

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

AR312944

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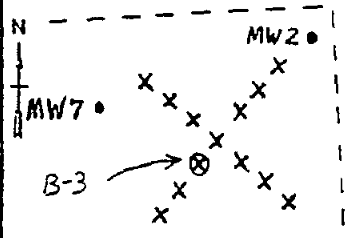
FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH



BORING NO.	B-3
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DAT	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-3 0-2	1.2	4, 6, 7, 12	TOP 0.3 Ft: Brownish red clayey topsoil with organics and rock Frags. 0.3 to 1.2: Red brown clay, silt w/ siltstone + shale frags.			
3	B-3 2-4	1.8	16, 30, 37, 47	Weathered bedrock: red brown siltstone and shale, dry-moist, more silt than above			
5	B-3 4-6	1.1	60, 68, 50/2"	Weathered siltstone: with some clay, larger Frags. and harder than above.	Water added For dust control after 4-6' spoon.		
7	B-3 6-8	1.7	29, 37, 27, 27	Weathered bedrock: red brown, less silt than above, more competent, harder than above			
9	B-3 8-10	0.7	20, 40, 50/2"	Weathered siltstone and shale: as above, more competent			
10							
11	—	0.2	45 50/1"	Weathered rock: as above, poor recovery due to competency, no jar sample taken			
15				EOB @ 18 Ft Rock @ 12 Ft Shelby Tube sample collected 0.0 to 2.3 Ft.			

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

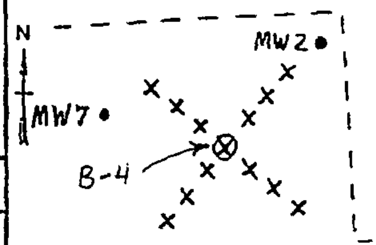
AR312945

HART

FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH MA



BORING NO.	B-4
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DATE	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-4 0-2	1.1	2, 3, 11, 15	Dry, clay rich topsoil to 0.4Ft, then red clay and silt with bedrock frags of soft to medium shale and siltstone			
3	B-4 2-4	1.4	10, 17, 24, 26	Weathered siltstone: little mica, red brown, higher silt content and harder than above, dry-moist			
5	B-4 4-6	1.0	29, 30, 49, 50/1"	Weathered rock: mostly siltstone, some shale, red brown, dry-moist			
7	–	0.2	50/4"	Red brown siltstone containing mica, hard. Poor recovery, no sample collected			
9	–	–	–	No recovery. Somewhat softer. Some shale.			
11	–	0.1	50/5"	Red brown siltstone as above. Poor recovery. No sample collected.			
15				EOB @ 10Ft Competent rock @ 10Ft			

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

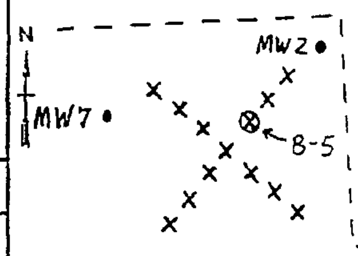
AR312946

HART

FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH MAP



BORING NO.	B-5
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / D J Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DATE	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-5 0-2	1.4	5, 5, 8, 10	Topsoil to 0.4 Ft w/ organics, then weathered rock, siltstone, silt, and gravel (F-M), little clay, red brown, dry			
3	B-5 2-4	1.2	10, 16, 23, 35	Weathered shale and siltstone with clay, some silt, red, moist, larger rock Frags than above			
5	B-5 4-6	1.3	30, 32, 33, 35	Weathered shale and siltstone, more silt than above. Brown shale + siltstone Frags, dry to moist.			
7	B-5 6-8	1.2	19, 23, 47, 50	Dry, red brown siltstone, Fairly competent, very little shale and clay, mostly gravel size, dry to moist.			
9	—	—	50, 50/0"	No recovery.			
10				EOB @ 12 Ft Rock @ 10 Ft			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

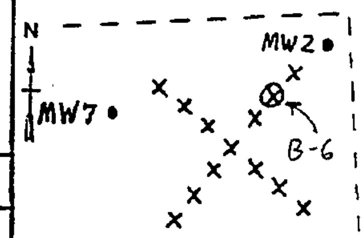
AR312947

HART

FRED C. HART ASSOCIATES, INC.

TEST BORING LOG

BORING/WELL LOCATION SKETCH M



BORING NO. B-6

PROJECT NO./NAME: C+D Recycling Site NY323-08

LOCATION: Freeland, PA

DRILLING CONTRACTOR/DRILLER: Summit Drilling / DJ Cramer

HART GEOLOGIST/OFFICE: Bryant/Albany

DRILLING EQUIPMENT/METHOD: Mobile B-80 / Air Rotary

SIZE/TYPE OF BIT: 6" Roller Bit

SAMPLING METHOD: 2" Split Spoon

START/FINISH DA: 8-2-90

WELL INSTALLED? YES ☐ NO ☒

CASING MAT./DIA.:

SCREEN: TYPE | MAT. | LENGTH | DIA. | SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE | TOP OF WELL CASING | TOP & BOTTOM SCREEN | GW SURFACE | DATE

REMARKS:

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-6 0-2	1.0	2, 10, 6, 4	Top 0.2 Ft topsoil w/organics, then large frags of red brown weathered siltstone, trace shale and clay, dry			
3	B-6 2-4	1.9	13, 21, 24, 25	Weathered red siltstone and shale, more clay than above, moist, fairly competent			
5	B-6 4-6	1.2	44, 49, 50/5"	Weathered brown to red brown siltstone and shale, More silt than above, less clay and shale frags, dry to moist	Water added to 6 Ft.		
7	—	0.2	50/2"	Weathered red brown siltstone, dry to moist, very poor recovery. No sample collected.	Powdered rock shows weak reaction to 10% HCl.		
10				EOB: 8 Ft Rock @ 7 Ft Cored from 8-13 Ft (see Coring Log)			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

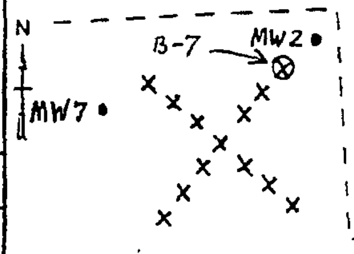
AR312948

FRED C. HART ASSOCIATES, INC.

HART

TEST BORING LOG

BORING/WELL LOCATION SKETCH M.



Field	Entry
BORING NO.	B-7
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DAT	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-7 0-2	1.3	2, 7, 7, 7	Top 0.2 Ft: Moist, red brown topsoil with organics 0.2-1.3 Ft: Weathered rock - shale and siltstone, clay rich, red moist to damp			
3	B-7 2-4	1.2	8, 27, 38, 50/5"	Weathered shale and siltstone as above, more competent, less clay, moist to damp at top			
5	—	0.3	50/4"	Red brown siltstone, hard. Cuttings show a grey colored zone @ 7 Ft.			
7							
10				EOB @ 8 Ft Rock @ 4 Ft			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%
Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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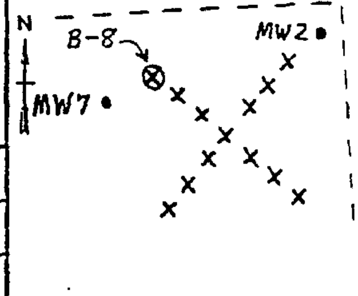
TEST BORING LOG

BORING/WELL LOCATION SKETCH M



BORING NO.	B-8
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant/Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DA	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-8 0-2	1.7	1, 2, 4, 7	Top 0.5 Ft: topsoil w/organics, then red brown silt, gravel, and clay. Weathered shale and siltstone frags, dry			
3	B-8 2-4	1.8	12, 13, 17, 19	Red to red brown, dry weathered siltstone, trace shale and clay. Fairly competent.			
5	B-8 4-6	1.5	33, 35, 39, 38	As above, red brown, moist, increase in clay and shale. Frags larger.			
7	–	–	50/4"	No recovery			
9	–	–	50/0"	No recovery			
10				EOB @ 8 Ft Rock @ 6 Ft			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%
Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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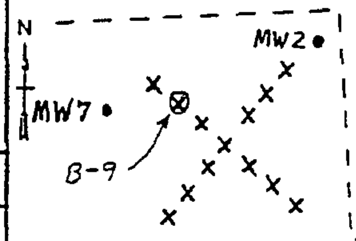
TEST BORING LOG

BORING/WELL LOCATION SKETCH MAP



BORING NO. B-9

PROJECT NO./NAME C+D Recycling Site NY323-08

LOCATION Freeland, PA

DRILLING CONTRACTOR/DRILLER Summit Drilling / DJ Cramer

HART GEOLOGIST/OFFICE Bryant/Albany

DRILLING EQUIPMENT/METHOD Mobile B-80 / Air Rotary

SIZE/TYPE OF BIT 6" Roller Bit

SAMPLING METHOD 2" Split Spoon

START/FINISH DATE 8-2-90

WELL INSTALLED? YES ☐ NO ☒

CASING MAT./DIA.

SCREEN: TYPE MAT. LENGTH DIA. SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE TOP OF WELL CASING TOP & BOTTOM SCREEN GW SURFACE DATE

REMARKS:

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-9 0-2	1.4	2, 4, 7, 8	Top 0.3Ft topsoil w/organics, then weathered red brown shale and siltstone, F-M gravel sized rock frags, and red brown clay and silt, dry to moist			
3	B-9 2-4	1.7	14, 15, 15, 15	Weathered siltstone and shale Shale + clay: red, moist Siltstone + silt: dry, red/brown/grey, mica rich	More competent w/ depth, larger frags		
5	B-9 4-6	1.2	30, 49, 50/3"	Weathered red grey siltstone with brown clayey weathered areas between fractures, trace shale	Fairly competent.		
7	—	0.1	50/2"	Weathered siltstone, poor recovery No sample collected.	Weak reaction w/ 10% HCl on powdered material		
10 15				EOB @ 8 Ft Rock @ 8 Ft Cored from 8 to 13 Ft (see Coring Log)			

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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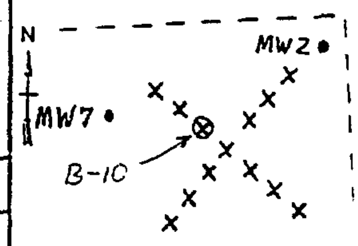
TEST BORING LOG

BORING/WELL LOCATION SKETCH



BORING NO.	B-10
PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant / Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DA	8-1-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE	
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-10 0-2	1.7	2, 3, 5, 8	Top 0.4 Ft: Dry red brown topsoil with organics 0.4 to 1.7 Ft: Red, very weathered shale and siltstone, clay rich, dry to moist, few rock frags.			
3	B-10 2-4	1.6	8, 13, 22, 25	Red to red brown weathered shale and siltstone, more rock and silt than above, dry			
5	B-10 4-6	1.1	37, 42, 50/3"	Red brown weathered siltstone and shale, silt and some clay. Siltstone frags larger and more abundant, dry to moist	More competent. Water added @ 6 Ft.		
7	B-10 6-8	0.5	50/4"	Red/gray/brown slightly weathered siltstone with mica, moist, very little clay			
9	—	—	50/5"	EOB @ 8 Ft Rock @ 6 Ft			
10							
15							

Proportions Used: Trace = 0–10%, Little = 10–20%, Some = 20–35%, And = 35–50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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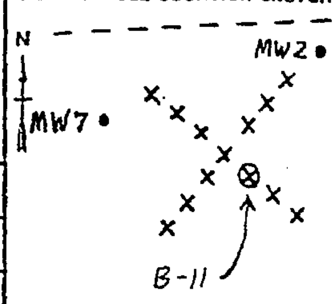
TEST BORING LOG

BORING/WELL LOCATION SKETCH



BORING NO. B-11

PROJECT NO./NAME: C+D Recycling Site NY323-08

LOCATION: Freeland, PA

DRILLING CONTRACTOR/DRILLER: Summit Drilling / DJ Cramer

HART GEOLOGIST/OFFICE: Bryant/Albany

DRILLING EQUIPMENT/METHOD: Mobile B-80 / Air Rotary

SIZE/TYPE OF BIT: 6" Roller Bit

SAMPLING METHOD: 2" Split Spoon

START/FINISH DATE: 8-3-90

WELL INSTALLED? YES ☐ NO ☒

CASING MAT./DIA.:

SCREEN: TYPE MAT. LENGTH DIA. SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE TOP OF WELL CASING TOP & BOTTOM SCREEN GW SURFACE DATE

REMARKS:

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHOLOGY
1	B-11 0-2	1.6	2, 4, 10, 12	Top 0.6 Ft brown silty topsoil with organics 0.6 to 1.6 Ft: Red brown, clayey, weathered siltstone, dry to moist. F-M gravel sized frags.			
3	B-11 2-4	1.0	8, 14, 12, 8	Weathered siltstone: red brown and clayey, then gray and mica rich, dry	Some water added from 0 to 6 Ft.		
5	B-11 4-6	1.6	19, 22, 24, 31	Weathered siltstone as above to 4.3 Ft, then weathered red brown clayey siltstone w/ less mica. Brown clay between rock frags. Moist clay 4.3 to 4.6 Ft	Dry to moist.		
7	–	0.7	24, 50/4"	Red brown clayey siltstone, fairly competent, some mica. Brown clay between frags, hard @ bottom.	Dry to moist.		
9	–	0.8	50, 50/3"	Red brown, clayey, mica rich siltstone, fairly competent, trace brown clay, some grey siltstone frags.	Dry to moist.		
10				EOB @ 10 Ft Rock @ 8 Ft			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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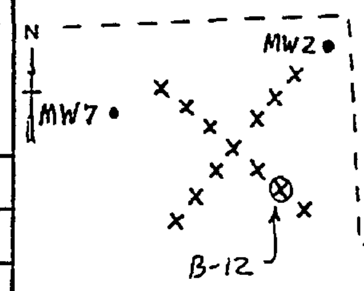
TEST BORING LOG

BORING/WELL LOCATION SKETCH MA[P]



BORING NO. B-12

PROJECT NO./NAME C+D Recycling Site NY323-08

LOCATION Freeland, PA

DRILLING CONTRACTOR/DRILLER Summit Drilling / DJ Cramer

HART GEOLOGIST/OFFICE Bryant/Albany

DRILLING EQUIPMENT/METHOD	SIZE/TYPE OF BIT	SAMPLING METHOD	START/FINISH DATE
Mobile B-80 / Air Rotary	6" Roller Bit	2" Split Spoon	8-2-90

WELL INSTALLED? YES ☐ NO ☒ CASING MAT./DIA. SCREEN: TYPE MAT. LENGTH DIA. SLOT SIZE

ELEVATION OF: (FT. ABOVE M.S.L.) GROUND SURFACE TOP OF WELL CASING TOP & BOTTOM SCREEN GW SURFACE DATE

REMARKS:

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/6"	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-12 0-2	0.8	2, 3, 4, 4	Top 0.5 Ft topsoil, then brown very weathered siltstone, mica rich, little clay			
3	B-12 2-4	1.0	15, 12, 13, 17	Weathered red to grey, mica rich, siltstone, moist. More clay than above. Brown clay between rock frags.	Water added from 0-6 Ft.		
5	B-12 4-6	1.2	35, 46, 50/4"	Weathered mica rich siltstone, more competent and less clay than above, larger frags @ bottom			
7	B-12 6-8	1.4	25, 25, 30, 27	As above. Brown clayey seams between fractures in siltstone. More competent at bottom.			
9	B-12 8-10	1.1	18, 24, 50/5"	Fairly competent red brown siltstone, less mica, more clay. No brown clay @ bottom	Weak reaction w/ 10% HCl		
10				EOB @ 10 Ft Rock @ 10 Ft Cored from 10 to 15 Ft (see Coring Log)			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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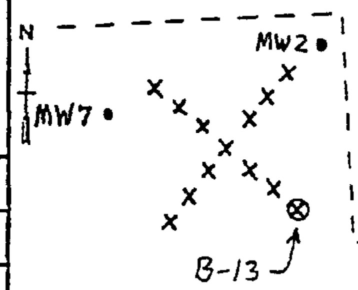
TEST BORING LOG

BORING NO. B-13

BORING/WELL LOCATION SKETCH M.



PROJECT NO./NAME	C+D Recycling Site NY323-08
LOCATION	Freeland, PA
DRILLING CONTRACTOR/DRILLER	Summit Drilling / DJ Cramer
HART GEOLOGIST/OFFICE	Bryant/Albany
DRILLING EQUIPMENT/METHOD	Mobile B-80 / Air Rotary
SIZE/TYPE OF BIT	6" Roller Bit
SAMPLING METHOD	2" Split Spoon
START/FINISH DAT	8-3-90
WELL INSTALLED?	YES ☐ NO ☒
CASING MAT./DIA.	
SCREEN: TYPE / MAT. / LENGTH / DIA. / SLOT SIZE	
ELEVATION OF: (FT. ABOVE M.S.L.)	GROUND SURFACE / TOP OF WELL CASING / TOP & BOTTOM SCREEN / GW SURFACE / DATE
REMARKS:	

LOG OF TEST BORING

DEPTH (FT)	SAMPLE NO. AND TYPE	RECOVERY (FT)	PENETRATION RESISTANCE BLOWS/FT	DESCRIPTION	REMARKS	WELL CONST.	GRAPHIC LITHO LOG
1	B-13 0-2	1.5	2, 4, 7, 7	Top 0.5 Ft: brown silty topsoil with organics 0.5 to 1.5 Ft: weathered red brown siltstone and shale, clay rich, moist, fine gravel sized frags.			
3	B-13 2-4	1.7	6, 7, 7, 5	Red brown weathered siltstone, mica rich, with less clay than above, some grey siltstone.			
5	B-13 4-6	1.0	50, 50/5"	Top 0.6 Ft same as above. Sharp contact @ 4.6 Ft to fairly competent, grey, hard, dry, mica rich siltstone (refusal)			
7	–	–	50/0"	No recovery.			
10				EOB @ 6 Ft Rock @ ~5 Ft			
15							

Proportions Used: Trace = 0-10%, Little = 10-20%, Some = 20-35%, And = 35-50%

Sampling Abbreviations: SS = Split Spoon, ST = Shelby Tube, CSC = Continuous Soil Core

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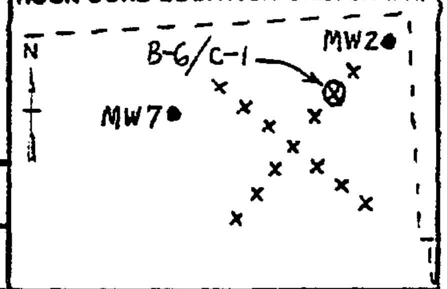
HART

ROCK CORE LOG

ROCK CORE LOCATION SKETCH MAP



BORING NO. B-6/C-1

PROJECT NO./NAME C+D Recycling Site NY323-08

LOCATION Freeland, PA

HART GEOLOGIST/OFFICE Bryant / Albany

START/FINISH DATE 8-2-90

DRILLING CONTRACTOR Summit Drilling

DRILLING EQUIPMENT Mobile B-80

DRILLER DJ Cramer

CORE BIT SIZE 2" NX

WATER SOURCE Truck mounted tank

WELL INSTALLED? YES ☐ NO ☒

T.D.-BOREHOLE 13 Ft

NO. OF CORE RUNS 1- 5Ft length (8-13 Ft BS)

THICKNESS AND TYPE OF OVERBURDEN 8 Ft weathered shale and siltstone bedrock

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

REMARKS:

DEPTH Ft	RUN NO.	CORE TIME MIN.	RECOVERY Ft	% RECOVERY	RQD %	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	GRAPHIC LOG.	REMARKS
8	1		5	100	43	8-9 Ft : Alternating beds of weathered siltstone and shale. Not representative : Fractured shale washed out during coring					No reaction with dilute HCl (10%)
9		2.5				9-10.1 Ft : Red-brown siltstone. Horizontal fractures every 2-3". Contacts are weathered	0°	W			
						Vertical fracture 9 to 10.4'	90°	W			
10		2.8				10.1 - 11.6 Ft : Red-brown siltstone. Numerous small to dime-sized vugs. Few horizontal fractures					Slight HCl reaction in some vugs.
11		2.7				11.6 - 13 Ft : Red-brown siltstone. Weathered surfaces gray. Horizontal fractures every 2-3". No vugs.	0°	W			
12		2.8				Vertical fractures at 11.9 to 12.1 and 12.7 to 13 Ft	90°	W			
13		2.3				END OF CORE 13 Ft					

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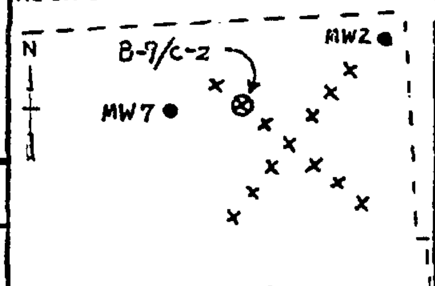
ROCK CORE LOG

BORING NO. B-9/C-2

ROCK CORE LOCATION SKETCH MAP



PROJECT NO./NAME	LOCATION
C+D Recycling Site NY323-08	Freeland, PA

HART GEOLOGIST/OFFICE	START/FINISH DATE
Bryant / Albany	8-2-90

DRILLING CONTRACTOR	DRILLING EQUIPMENT	DRILLER	CORE BIT SIZE
Summit Drilling	Mobile B-80	DJ Cramer	2" NX

WATER SOURCE	WELL INSTALLED?	T.D.-BOREHOLE	NO. OF CORE RUNS
Truck mounted tank	YES ☐ NO ☒	13 Ft	1 - 5 Ft length (8-13 Ft BS)

THICKNESS AND TYPE OF OVERBURDEN
8 Ft weathered siltstone and shale bedrock

REMARKS:

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH Ft	RUN NO.	CORE TIME MIN.	RECOVERY Ft	% RECOVERY	RQD %	ROCK CORE DESCRIPTION	CRACKS ANGLE	CRACKS COND.	CRACKS SPACING	GRAPHIC LOG	REMARKS
8	1		4.4	87	0	8-10 Ft: Generally very soft and washed out. Likely shale interbeds among siltstone. More siltstone and increased competence with depth.					Noncalcareous throughout based on 10% HCl test
9		1.4				8-9.9 Ft: Red-gray siltstone with trace sand and brownish clay lining fractures. Mica rich. Increase in sand towards base. Abundant horizontal fractures.	0°	W			Slow water loss from 8 to 10 Ft.
10		1.3				Vertical fracture 8.2 to 8.8.	90°	W			
11		2.8				9.9-11 Ft: Sharp lithologic change to red-brown shaly siltstone. Clay rich, mica poor, no sand. Fewer horizontal fractures. No vertical fractures.					
12		2.6				11-12.4 Ft: As above, more bedding plane fractures, increased clay.	0°	W			
						Vertical fractures at 11 to 11.1, 11.4 to 11.6, and 11.9 to 12.0.	90°	W			
13		1.6				END OF CORE 13 Ft					

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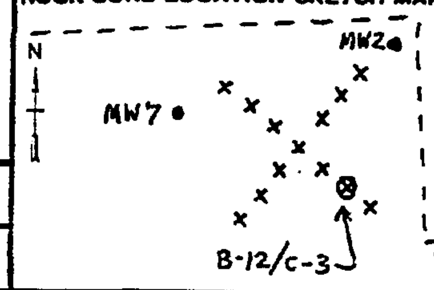
ROCK CORE LOG

ROCK CORE LOCATION SKETCH MAP



BORING NO. B-12 / C-3			
PROJECT NO./NAME C+D Recycling Site NY323-08	**LOCATION** Freeland, PA		
HART GEOLOGIST/OFFICE Bryant / Albany	**START/FINISH DATE** 8-2-90		
DRILLING CONTRACTOR Summit Drilling	**DRILLING EQUIPMENT** Mobile B-80	**DRILLER** D.J. Cramer	**CORE BIT SIZE** 2" NX
WATER SOURCE Truck mounted tank	**WELL INSTALLED?** YES ☐ NO ☒	**T.D.-BOREHOLE** 15 Ft	**NO. OF CORE RUNS** 1 - 5 Ft length (10-15' BS)
THICKNESS AND TYPE OF OVERBURDEN 10 Ft weathered mica rich, then clay rich siltstone			
REMARKS:			

GROUNDWATER OBSERVATION
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time
At ___ Ft. ___ Date ___ Time

DEPTH (FT)	RUN NO.	CORE TIME (MIN)	RECOVERY (FT)	% RECOVERY	RQD %	ROCK CORE DESCRIPTION	CRACKS: ANGLE	CRACKS: COND.	CRACKS: SPACING	GRAPHIC LOG	REMARKS
10	1		4.7	95	0	red-brown siltstone with trace sand at 10 Ft grading to red-brown mudstone/shale with trace silt at 15 Ft.					Noncalcareous throughout based on 10% HCl test.
11		2.2				Numerous small vugs + clay rich at 11.3 to 12.6 Ft and 13.8 to 14.1 Ft.					
12		2.3				Horizontal Fractures throughout spaced at 1-3 inches					
13		2.2				Vertical fractures at 11.5 to 11.9 and 13.3 to 13.4.	90°	W			
						High angle Fracture 12.2 to 12.4	75°	W			
14		1.3				Fine wavy laminae throughout.					
15		2.4				END OF CORE 15FT					

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APPENDIX 6D
HYDROGEOLOGIC CHARACTERIZATION

RI Sections 3.7.4, 3.7.4.1 and 3.7.4.2
RI Figures 3-19 to 3-38
RI Tables 3-32 and 3-33

The deep monitoring wells, on the other hand, show a wide range in hydraulic conductivity values, from 2.8 x 10^{-4} to 0.75 ft/day. One other deep well on-site, MW-8D2, is nonproductive. These 4 wells all tap zones between 1437 and 1467 ft. (AMSL). It is apparent that fractures in this zone are fewer in number, less well developed, probably smaller in width due to the weight of the overlying rock and are less likely to be interconnected. This conclusion is supported by information in the core logs (Appendix D) which indicate numerous closely spaced fractures near the surface. The number of fractures then decreased in the deeper cores and fewer of these lower fractures produced water except for those identified in the lower fracture zone (see Section 3.7.1--Packer Testing). The lack of water in horizontal fractures between the two zones may be due to lack of interconnection between them and/or a lack of vertical fractures in these areas. Fractures in the lower zone, though fewer in number, may have somewhat better interconnection and may intersect the regional large scale vertical fractures (see Section 2.6.1--Fractures and Groundwater Movement). This will be more fully discussed in the next section.

3.7.4 Groundwater Elevation and Flow. Groundwater flows in response to differences in pressure within an aquifer--from areas of higher pressure toward areas of lower pressure. The amount of pressure in any part of an aquifer is reflected by the height to which water rises within a well that taps that point. To determine the direction of groundwater flow, the elevation of the groundwater must be known at a minimum of three different points within the same aquifer. The term aquifer as used here means the rock or unconsolidated deposits are permeable to some extent so that water is able to move either through the primary pore spaces or through secondary fractures or solution pathways. This is an important point with regard to the Site because as noted in the previous section (3.7.3) more than one aquifer is present in the rocks underlying the Site. Groundwater flow directions must therefore be determined using water level information from wells that tap only a single aquifer. Water levels in wells that tap more than one aquifer can not be used to determine flow directions because the pressure represented by the water level in such a well is a combination of pressures in both aquifers which precludes comparison with water levels in any other well.

Prior to specific interval monitoring well construction at the Site in the spring of 1989, the seven on-site monitoring wells were open boreholes that intersected fractures from more than one aquifer. Water level measurements in these open boreholes obtained between June 1988 and April 1989 are summarized in Table 3-32. Boreholes open over large intervals which yield water level data resulting from composite pressures can mask subtle variations in distinct zones which may occur during seasonal changes. In fact, wells such as these can change the local groundwater flow patterns by creating a connection and allowing flow between two aquifers that were formerly separated. For this reason the open boreholes present on-site were reconstructed so that the connection between the two aquifers was eliminated and each monitoring well taps a specific fracture zone in only one of the two aquifers. An example of this point is shown graphically in Figure 3-19. The left hand portion of the graph shows the water levels obtained from MW-1 which was an open borehole to a depth of 250 ft. This well was converted to MW-1D with a screened interval of 16 ft. from 195 to 211 ft. below surface. MW-1S was drilled adjacent to MW-1D. MW-1S also has a 16 ft. screened interval from 44 to 60 ft. below surface. Water levels measured in MW-1S and MW-1D are shown on the right portion of the graph. This graph clearly shows that there are two separate aquifers present beneath the Site because of the large difference in the potentiometric surface between MW-1S and MW-1D. The water levels in MW-1 (open hole) are clearly a composite of the pressures from the two aquifers present which means that open borehole wells at the Site which tap both zones cannot be used to determine groundwater flow directions.

Table 3-32. Open Borehole Water Level Elevations

C & D Recycling Site Remedial Investigation

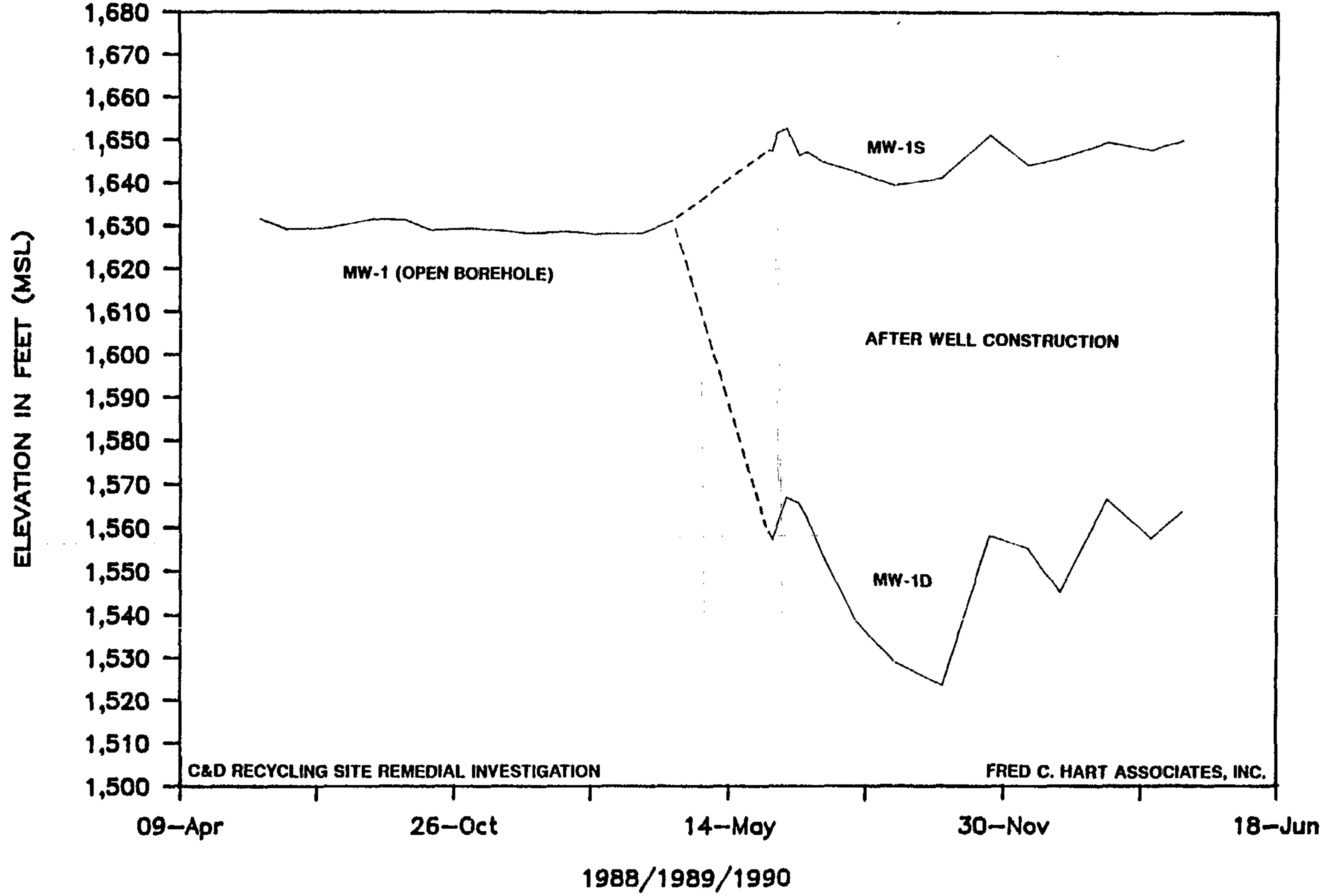
Well I.D.	MW-1	MW-2	MW-3	MW-4	MW-5	MW-6	MW-8	Pond
T.O.C.*	1655.12	1768.20	1695.93	1627.87	1659.81	1692.45	1693.73	1608.97**
Groundwater Elevations by Date								
06-07-88	1631.70	NA	1654.27	1616.64	1651.58	1610.68	1660.13	1608.97
06-27-88	1629.12	1588.68	1644.39	1612.48	1645.91	1599.08	1649.73	1606.15
07-26-88	1629.38	1543.74	1655.10	1617.92	1653.20	1582.33	1664.82	NA
08-29-88	1631.69	NA	1644.42	1612.33	1644.43	1583.86	1648.07	1605.82
09-22-88	1631.29	NA	1647.40	1612.79	1645.60	1583.00	1651.10	1606.02
10-11-88	1628.82	NA	1641.45	1610.77	1641.61	1572.75	1645.31	NA
11-09-88	1629.36	1527.67	1649.33	1617.05	1647.81	1594.00	1653.63	1608.57
12-21-88	1628.12	1543.90	1646.72	1614.14	1646.01	1612.59	1650.13	1608.77
01-18-89	1628.67	1545.50	1647.83	1615.22	1646.73	1611.75	1651.45	1608.87
02-07-89	1628.03	1546.76	1646.09	1614.58	1645.05	1609.78	1649.33	1608.62
03-14-89	1628.42	1549.20	1647.55	1614.72	1645.81	1615.64	1650.43	1608.82
04-04-89	1631.44	NA	1656.91	1619.66	1652.83	1622.04	1663.73	NA

*Top of casing.
**Pond elevation based on staff guage reading of 3.0 feet (1608.97 feet, AMSL) on June 8, 1988.
NA = Not Available.
All elevations in feet above mean sea level (AMSL).

FIGURE 3-19

C&D RECYCLING WATER LEVELS

MW–1 BEFORE & AFTER WELL CONSTRUCTION



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3.7.4.1 Groundwater Elevations. The collection of water level information from the reconstructed monitoring wells began in mid-June of 1989. In addition to the fourteen new monitoring wells, water levels were also measured in the existing wells inside and outside of the milkhouse, the existing monitoring wells MW-2 and MW-4 and the artesian well located in the old well house south of MW-1S and MW-1D. [Depth and construction information for the open borehole wells constructed by Weston can be found in the Roy F. Weston letter report dated August 15, 1985 (Back and Tomalavage, 1985). Information on the artesian and milkhouse wells can be found in the Roy F. Weston letter report dated July 31, 1985 (Tomalavage, 1985).] A staff gauge was also established in the pond south of the Site to monitor water level fluctuations in the pond. The data are summarized in Table 3-33. Water levels were measured by means of an electronic water level detector which was used to determine the depth to water relative to the top of the well casing. Water level elevations were determined by subtracting the depth to water from the top of casing elevation. Top of casing elevations were established by a licensed surveyor and are accurate to 0.01 feet.

Water level measurements were taken weekly during the latter portion of June and in July, and monthly thereafter. Note that the water levels measured in June may not accurately reflect the true water level in many of the wells. Water levels may not have fully equilibrated from well development following construction, purging for the June sampling event, and pumping from the individual hydraulic conductivity tests, all of which occurred during this period. One well in particular, MW-5D, did not fully recover until mid-August due to the low hydraulic conductivity (Figure 3-18).

Graphs showing water level changes over time for most of the wells and the pond, are shown in Figures 3-20 to 3-23. Graphs for MW-5M, MW-9M, and the milkhouse inside wells are not shown because water levels in these wells are nearly identical to water levels in MW-5S, MW-9S, and the milkhouse outside well, respectively. Wells MW-8D2 and MW-2 are also not graphed because these two wells are nonproductive and MW-4 is not graphed because this existing open borehole taps more than one aquifer. Water levels for MW-8D2, MW-2 and MW-4 shown in Table 3-33 are not considered an accurate reflection of the potentiometric surface at these locations.

Table 3-33

Groundwater Elevations After Monitor Well Completion
C & D Recycling Site Remedial Investigation

Well ID	MW-1S	MW-1D	MW-2	MW-3	MW-4S	MW-4	MW-5S	MW-5M	MW-5D	MW-6S	MW-6D	MW-7	MW-8S	MW-8D2	MW-9S	MW-9M	Artesian	Pond Gauge	Milkhouse Outside	Milkhouse Inside
Elevation Top of Steel Casing	1655.71	1655.12	1768.20	1695.93	1628.55	1627.87	1659.52	1659.81	1660.67	1692.72	1692.45	1731.93	1694.65	1694.45	1678.80	1678.83	1641.87	1608.97	1674.33	1670.88
Groundwater Elevations By Date																				
06/12/89	1647.62	1558.96	1568.92	1652.86	1616.86	1617.04	1650.63	1650.72	1559.35	1654.88	1573.30	1665.89	1654.78	-------	1648.42	1648.62	Flowing	-------	-------	-------
06/15/89	1647.28	1557.20	1568.39	1652.53	1616.80	1617.52	1650.12	1650.22	1522.48	1654.50	1556.16	1666.93	1653.73	-------	1647.82	1648.01	Flowing	1609.39	-------	-------
06/19/89	1651.65	1560.62	1568.63	1661.63	1621.59	1622.24	1655.71	1655.88	1507.88	1654.50	1559.23	1669.18	1660.33	-------	1652.28	1652.50	Flowing	1609.39	1660.32	1659.70
06/26/89	1652.86	1566.97	1569.70	1667.32	1621.89	1622.59	1657.76	1657.92	1529.92	1662.83*	1565.73	1671.51	1664.41	-------	1653.54	1653.85	Flowing	1609.39	1661.48	1661.04
07/05/89	1646.40	1565.53	1590.30	1662.16	1617.50	1618.30	1653.34	1653.46	1575.92	1657.88	1564.97	1666.73	1658.46	-------	1650.02	1650.25	Flowing	1609.22	1656.81	1656.66
07/11/89	1647.30	1562.33	1570.27	1658.36	1616.55	1616.67	1650.75	1650.86	1609.32	1655.12	1561.73	1665.78	1654.70	-------	1647.70	1647.91	Flowing	1609.07	1653.38	1653.31
07/18/89	1645.79	1557.02	1569.52	1652.93	1614.76	1614.90	1648.41	1648.52	1625.17	1652.15	1556.38	1664.29	1652.01	-------	1646.03	1646.22	Flowing	1606.37	1650.86	1650.78
07/24/89	1644.74	1552.65	1568.37	1649.84	1613.76	1613.87	1647.29	1647.37	1631.51	1650.89	1552.04	1663.38	1650.75	-------	1645.12	1645.33	1641.37	1607.37	1649.39	1649.47
08/15/89	1642.71	1538.83	1561.66	1644.68	1611.57	1611.60	1643.79	1643.84	1637.70	1646.54	1538.24	1661.44	1646.85	1443.85	1642.78	1642.88	1639.64	1605.77	1647.10	1647.32
09/13/89	1639.44	1528.91	1552.51	1642.11	1610.27	1610.24	1641.85	1641.16	1637.98	1644.16	1528.39	1660.87	1644.67	1446.95	1639.62	1639.70	1636.30	1605.37	1643.00	1642.99
10/18/89	1641.27	1523.39	1545.79	1644.05	1610.91	1610.87	1641.67	1641.68	1636.82	1645.47	1523.00	1662.05	1646.29	1447.60	1641.19	1641.31	1638.22	1605.37	1647.33	1647.24
11/21/89	1651.28	1558.13	1549.63	1664.59	1621.67	1621.74	1656.92	1657.07	1642.89	1661.86	1557.15	1669.33	1664.52*	1448.93	1652.64	1652.98	Flowing	1609.57	1659.32	1659.47
12/19/89	1644.12	1555.13	1555.36	1648.47	1613.82	1613.89	1646.03	1646.08	1643.62	1649.28	1554.72	1663.67	1649.56	1449.56	1644.14	1644.29	1640.97	1608.57	1648.08	1648.04
01/11/90	1645.84	1544.99	1556.41	1648.58	1615.42	1615.57	1646.11	1646.13	1642.72	1648.73	1544.59	1664.34	1648.66	1450.08	1645.53	1645.66	Flowing	1607.47	1651.66	1651.63
02/15/90	1649.69	1566.62	1568.36	1662.68	1619.08	1619.13	1653.63	1653.75	1651.20	1658.20	1566.33	1667.28	1659.05	1450.44	1656.16	1656.41	Flowing	Missing	1656.77	1656.89
03/19/90	1647.73	1557.52	1572.67	1652.55	1618.00	1617.99	1650.18	1650.26	1648.03	1653.36	1557.16	1665.26	1652.74	1451.62	1648.05	1648.22	Flowing	Missing	1653.74	1653.90
04/11/90	1650.11	1563.81	1576.33	1662.64	1619.20	1619.04	1653.75	1653.85	1651.90	1658.29	1563.55	1667.65	1658.60	1452.09	1650.58	1658.85	Flowing	Missing	1657.72	1657.92
05/16/90	1652.19	1565.22	1578.81	1664.41	1621.06	1621.06	1656.31	1656.45	1653.03	1660.74	1564.95	1668.83	1661.71	1452.77	1652.99	1653.23	Flowing	Missing	1660.85	1660.55

FIGURE 3-20

C&D RECYCLING WATER LEVELS

SHALLOW WELLS – NORTH

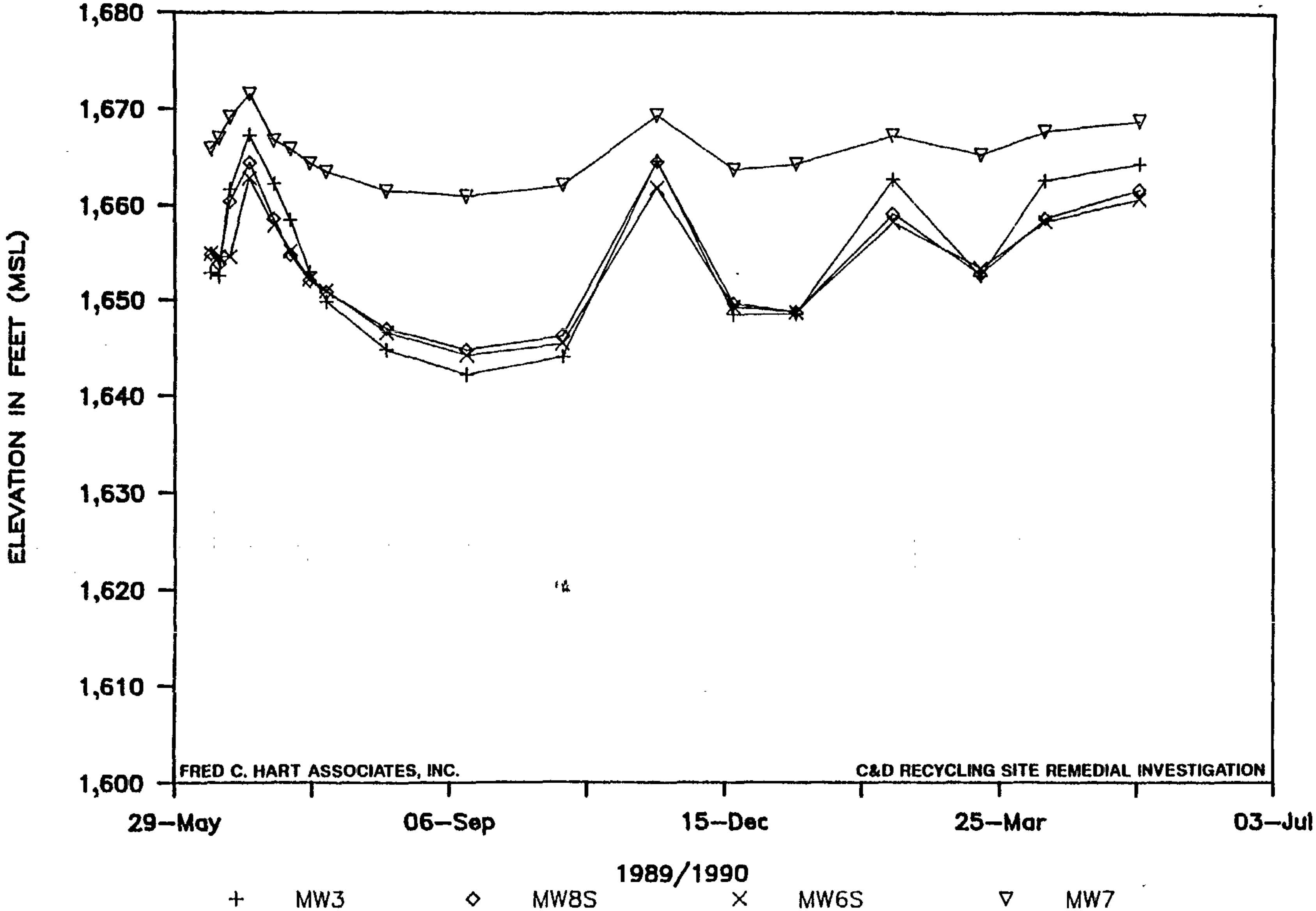

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FIGURE 3-21

C&D RECYCLING WATER LEVELS

SHALLOW WELLS – CENTRAL AND SOUTHERN

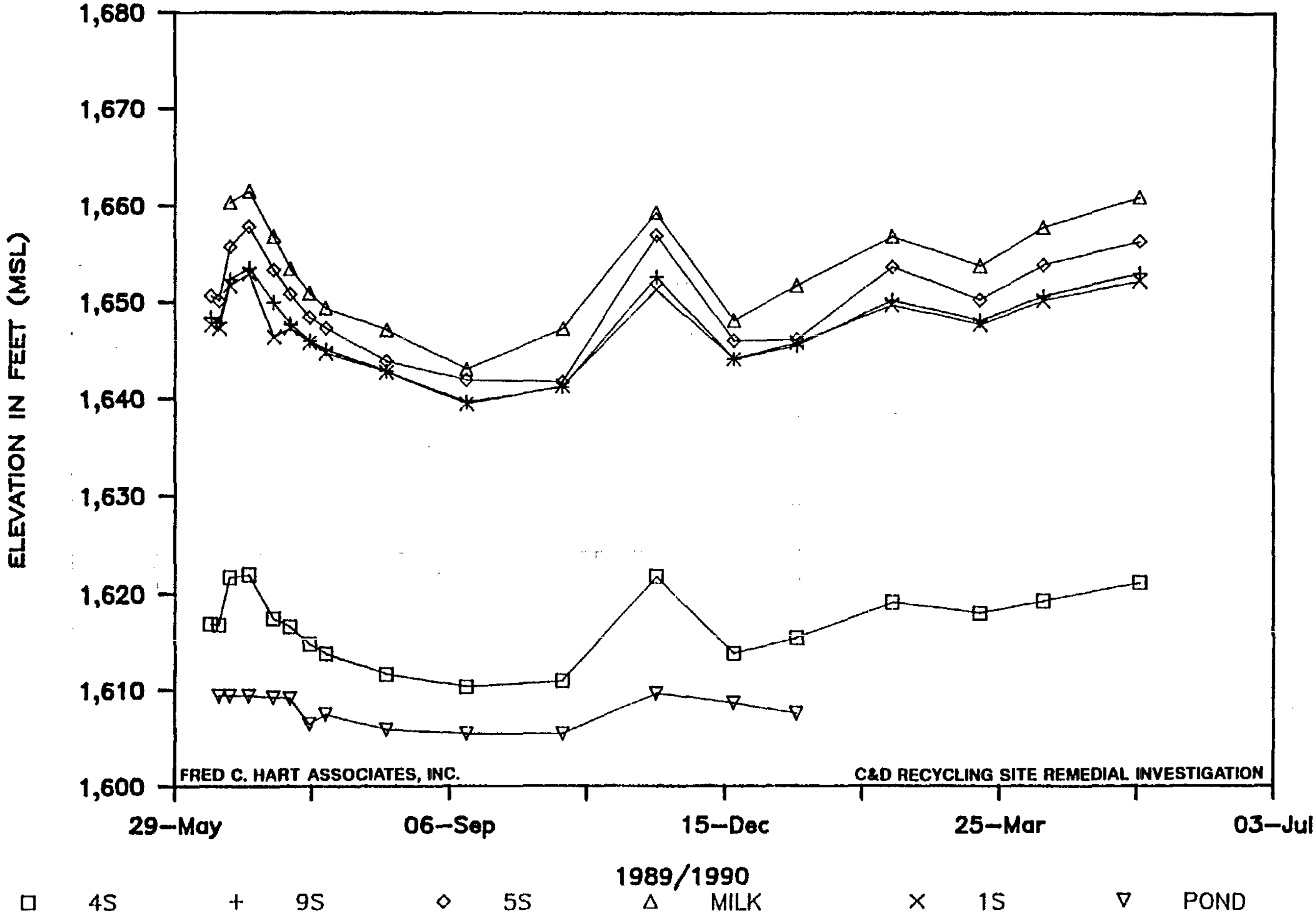


FIGURE 3-22

C&D RECYCLING WATER LEVELS

DEEP WELLS WITHOUT MW5D

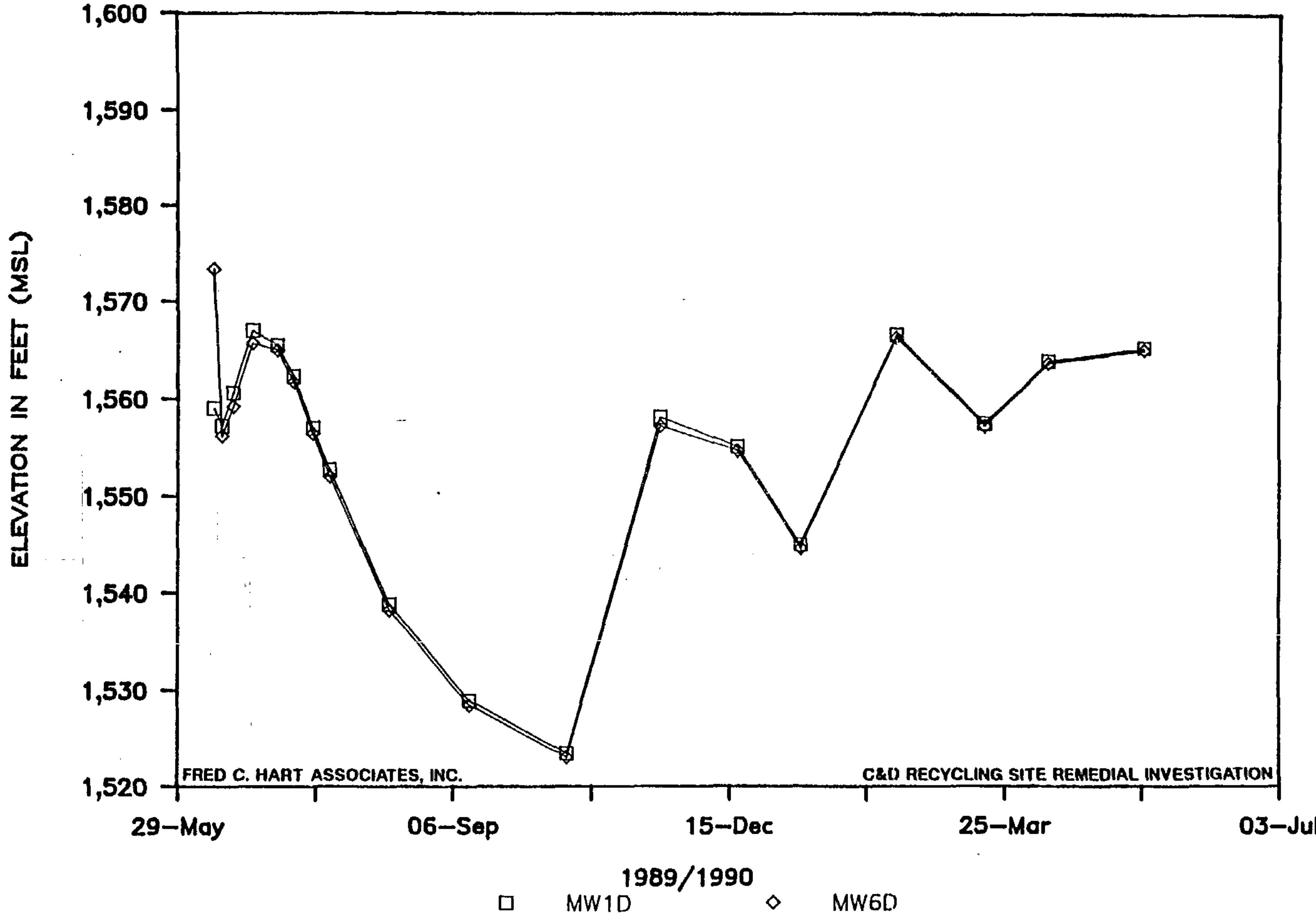
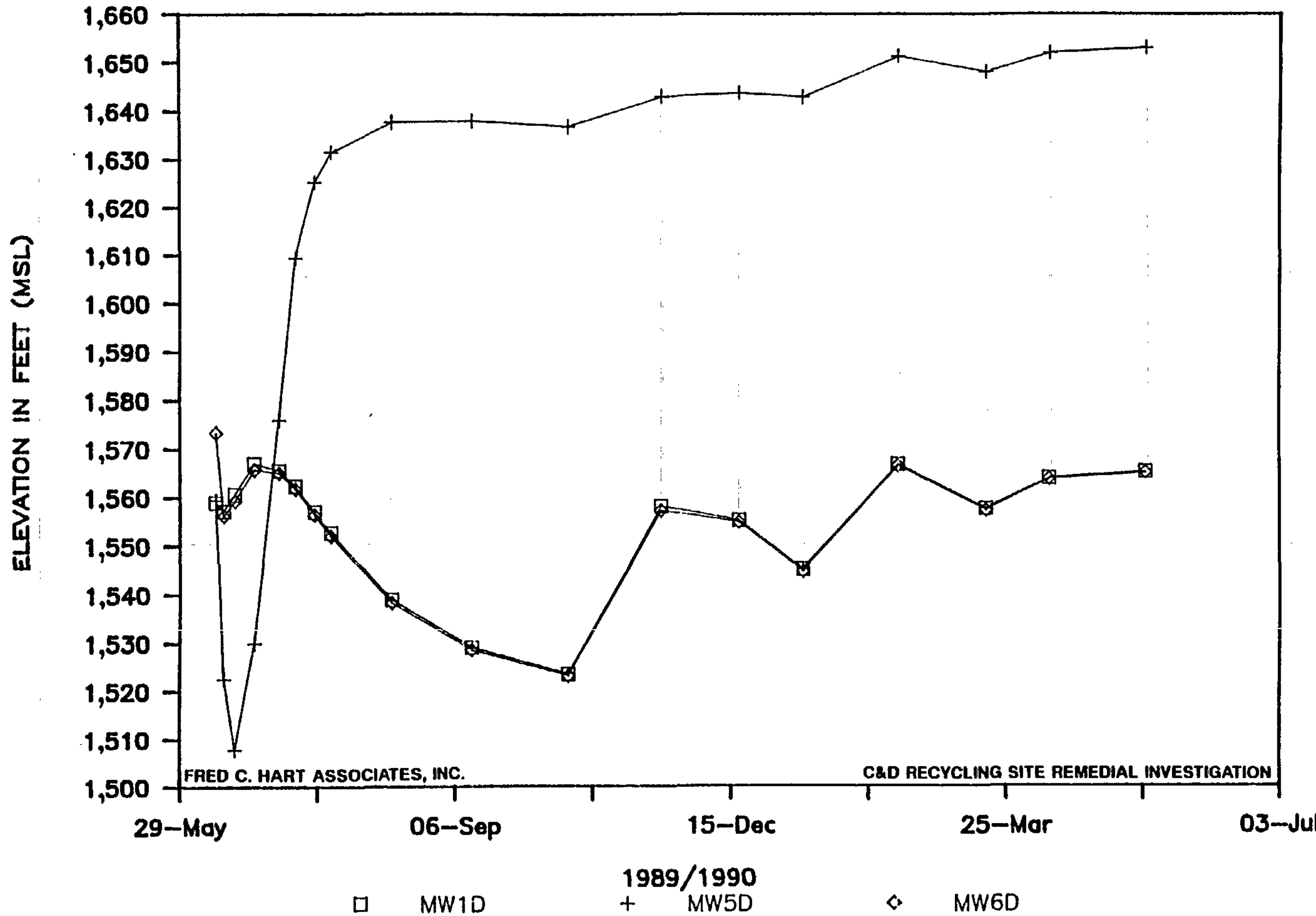


FIGURE 3-23

C&D RECYCLING WATER LEVELS

DEEP WELLS



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In addition to the monthly water level measurements, continuous water level recorders were installed in monitoring wells MW-6S and MW-6D to document daily changes in water levels in response to rainfall events. The recorders used were manufactured by Telog Instruments, Inc., model number WLS-2109 with Druck, Inc. PDCR 800 series pressure transducers. The recorders were programmed to take water level measurements hourly and data were collected from July 1989 through April 1990. This information was periodically downloaded onto a portable computer.

The continuous water level data collected at MW-6S and MW-6D are presented in Figures 3-24 and 3-25, respectively. These graphs were constructed using daily measurements as recorded by the instrument at noon each day. The early data gaps in Figure 3-25 are the result of the limited range of the transducer (about 35 ft.). Although the transducer was lowered ten feet in August, the rapid water level decline in MW-6D resulted in loss of the data after August 29, 1989. The lack of extra cable for this well prevented collection of water level data until the water level rose above 1532.4 ft. (AMSL) on October 25, 1989. The later data gaps were due to recorder malfunction caused by excessive moisture from condensation in the pressure equalization tube which shorted out the transducer. This occurred at the beginning of March, 1990. Monthly water level measurements using a water level indicator have been included in Figure 3-25 to fill in the data gaps to the extent possible.

The graph for continuous water level information from MW-6S (Figure 3-24), which includes available daily precipitation data obtained from NOAA, indicates that the shallow aquifer responds quickly to heavy rainfall events because recharge to the aquifer occurs quickly from direct infiltration of rainwater. Note that greater recharge occurred from heavy rain in September, October and November as evidenced by the larger water level peaks. This is for the most part caused by the lack of evapotranspiration by plants in the autumn months.

FIGURE 3-24

CONTINUOUS WATER LEVEL RECORDER DATA

MONITORING WELL MW-6S

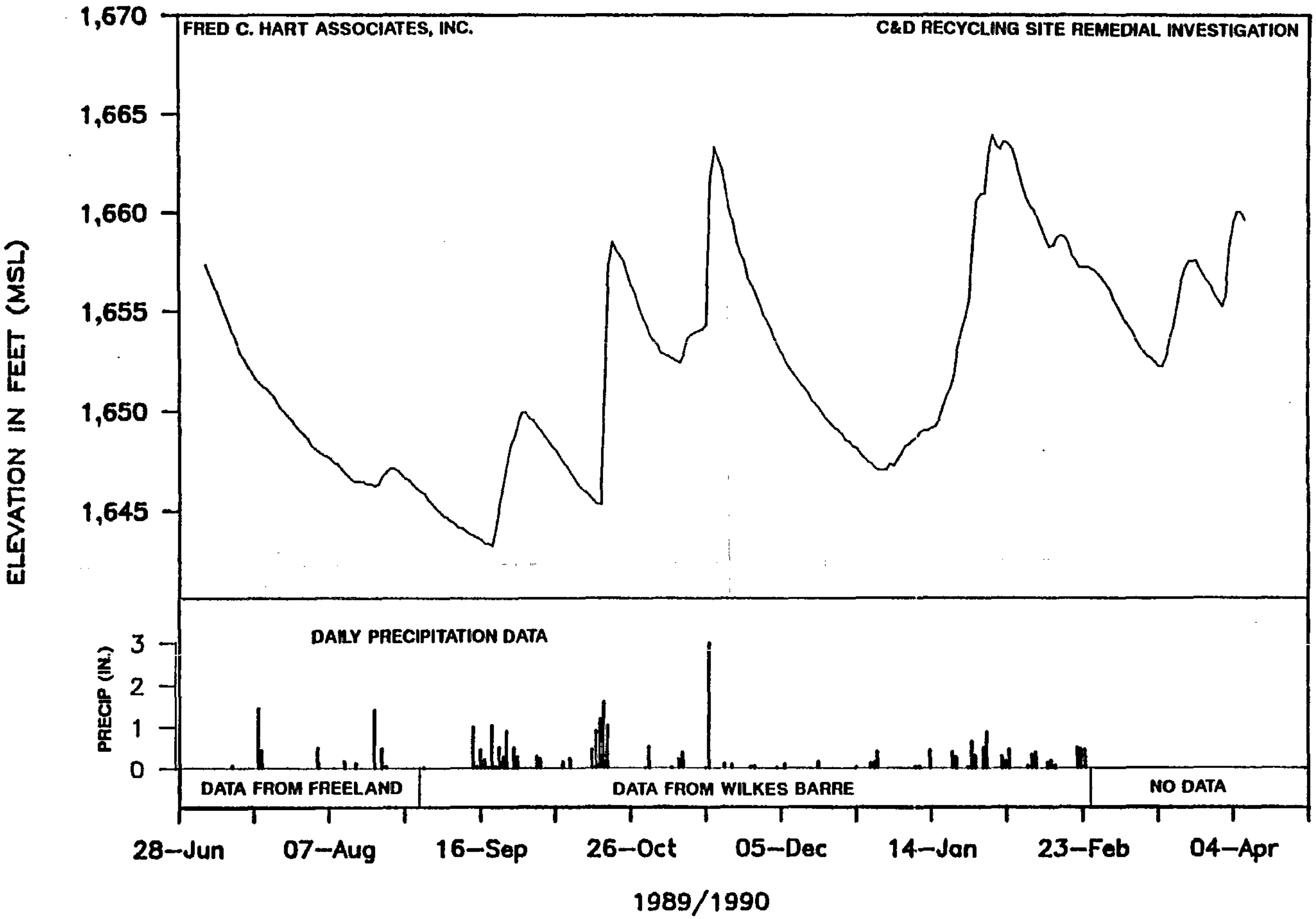
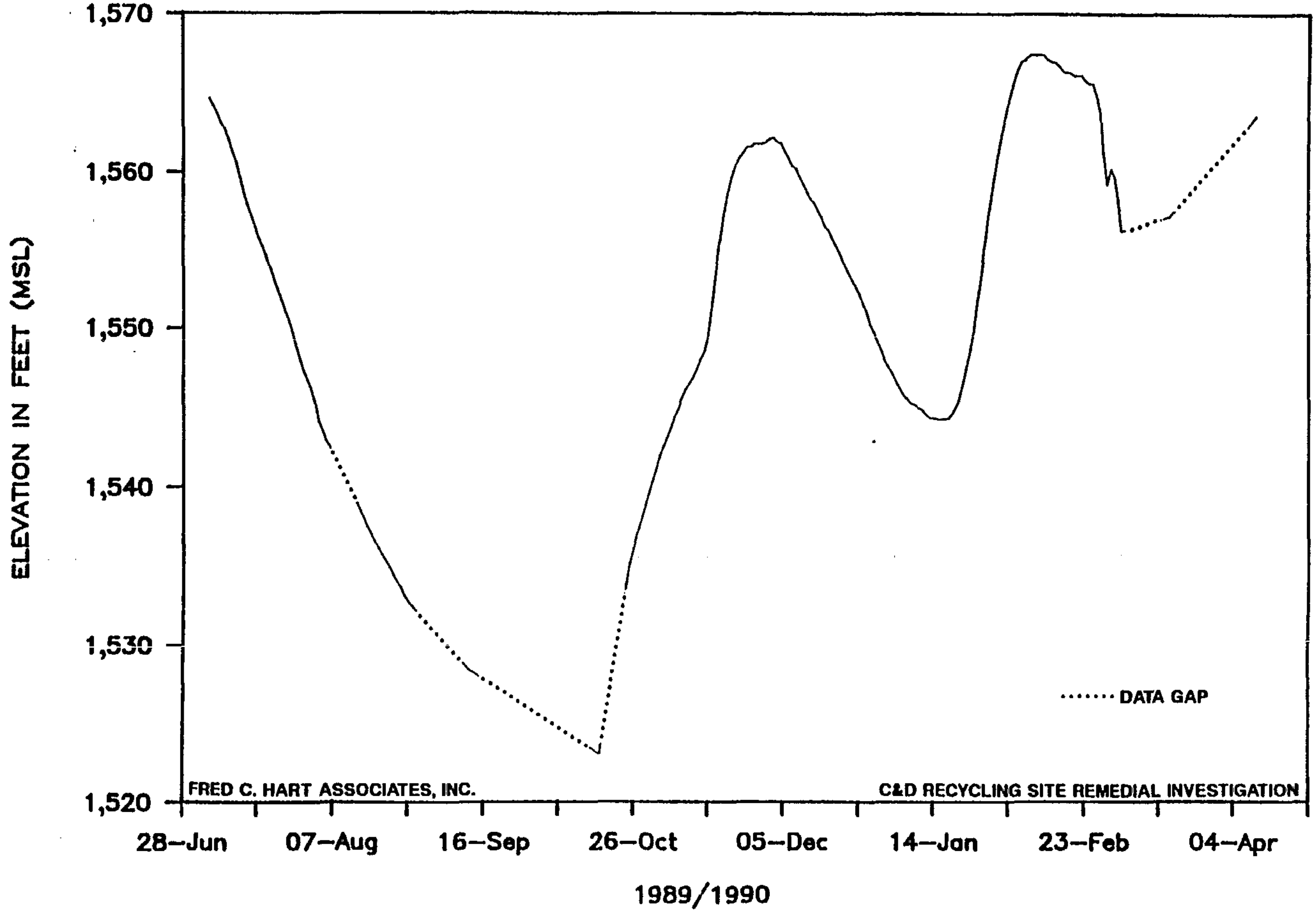


FIGURE 3-25

CONTINUOUS WATER LEVEL RECORDER DATA

MONITORING WELL MW–6D



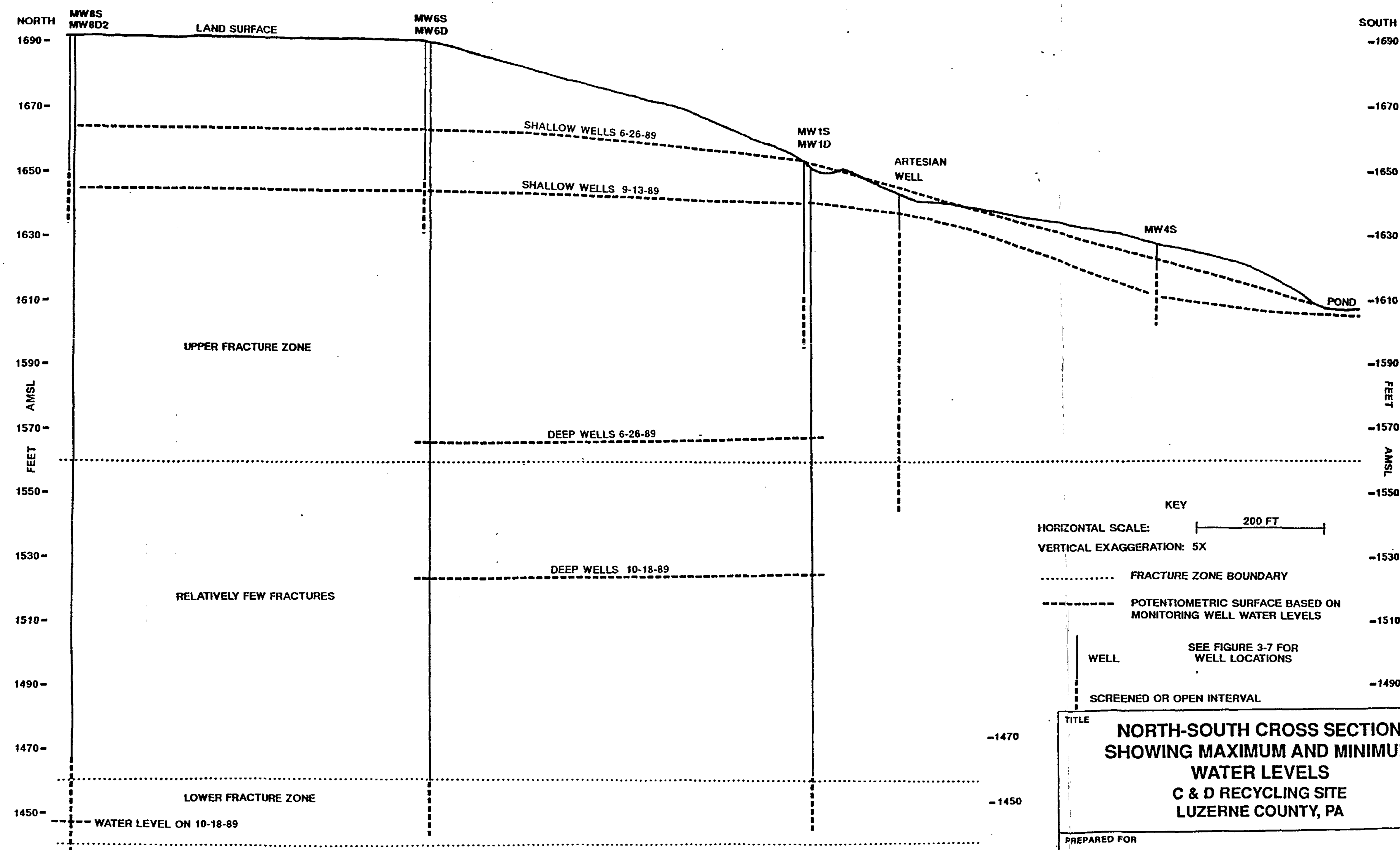
The rapid water level decline following the peaks indicates that the aquifer is well connected and that a discharge point is located nearby. The large peak in late January and early February is due to the heavy rains during this period and by the unusually warm weather. Had the weather been colder, little recharge would have occurred because the precipitation would have been in the form of snow. This will be discussed further in Section 3.7.4.2.

Continuous water level information from MW-6D (Figure 3-25) indicates that the deep aquifer responds much more slowly to rainfall events because recharge does not occur from direct infiltration of rainwater near the site. The graph shows fewer peaks that rise and fall gradually and not in response to specific rainfall events. The lag time between the water level peaks in the shallow well and water level peaks in the deep well is approximately two weeks.

With the exception of an increase in water level during the month of June which was experienced in all wells except MW-5D, all wells show the expected decrease in water level elevations through the September 1989 measurement. In the case of the shallow wells, water levels began to rise in October and continued to rise into November with increases as great as twenty feet resulting from heavy rains in late October and early November. As mentioned above, water level response in the shallow wells was fairly rapid. Recharge then ceased in late November and into December resulting from the inception of very cold weather, and shallow well water levels dropped significantly. In January and early February a large amount of recharge occurred because of unusually warm weather. Precipitation data was not available beyond February 1990.

In the deep wells, water levels continued to decline in October indicating a lag time between rainfall events and recharge to the aquifer. It is probable that recharge to the deep aquifer is derived from slow leakage from the shallow aquifer or that the catchment area is distant from the Site. In November, water levels in MW-6D and MW-1D rose approximately thirty-five feet while the level in MW-5D increased about six feet. In December, the water level in MW-5D continued to rise very slowly while levels in MW-6D and MW-1D began to decline. This indicates that there is no connection between MW-5D and the other two wells or that this is an area of leakage between the upper and lower aquifers (see below). Recharge in the deep aquifer in January and February is similar to that in the upper aquifer except that the response is more subdued and lags behind the response of the shallow aquifer to recharge.

It is clear that there are two separate water bearing zones in the rocks beneath the Site. Evidence to support this includes the approximate two week lag time in water level response to precipitation. There is also a consistent difference of approximately 100 feet between water levels in MW-1S and MW-1D as well as MW-6S and MW-6D. The separation between these two zones is also apparent when comparing the open borehole water level graphs with those for the reconstructed monitoring wells (Figure 3-19). Based on this information and that from the coring, drilling, and geophysical logging, two separate water-bearing fracture zones have been defined. The upper zone consists of a series of closely spaced horizontal and vertical fractures that are present at elevations between 1560 and 1660 feet above mean sea level (AMSL). The lower zone is thinner and contains a few water bearing horizontal fractures at elevations between 1440 and 1460 feet AMSL. Separating these two zones is approximately 100 feet of more massive siltstone and shale with a few non-water bearing fractures. This information is shown graphically on Figure 3-26 which is a cross section trending north-northwest to south-southeast across the Site.



ADAPTED FROM: McLAREN/HART - 1991

TITLE
NORTH-SOUTH CROSS SECTION SHOWING MAXIMUM AND MINIMUM WATER LEVELS
C & D RECYCLING SITE
LUZERNE COUNTY, PA

PREPARED FOR
AT & T - NASSAU METALS

ERM-Northeast
Environmental Resources Management

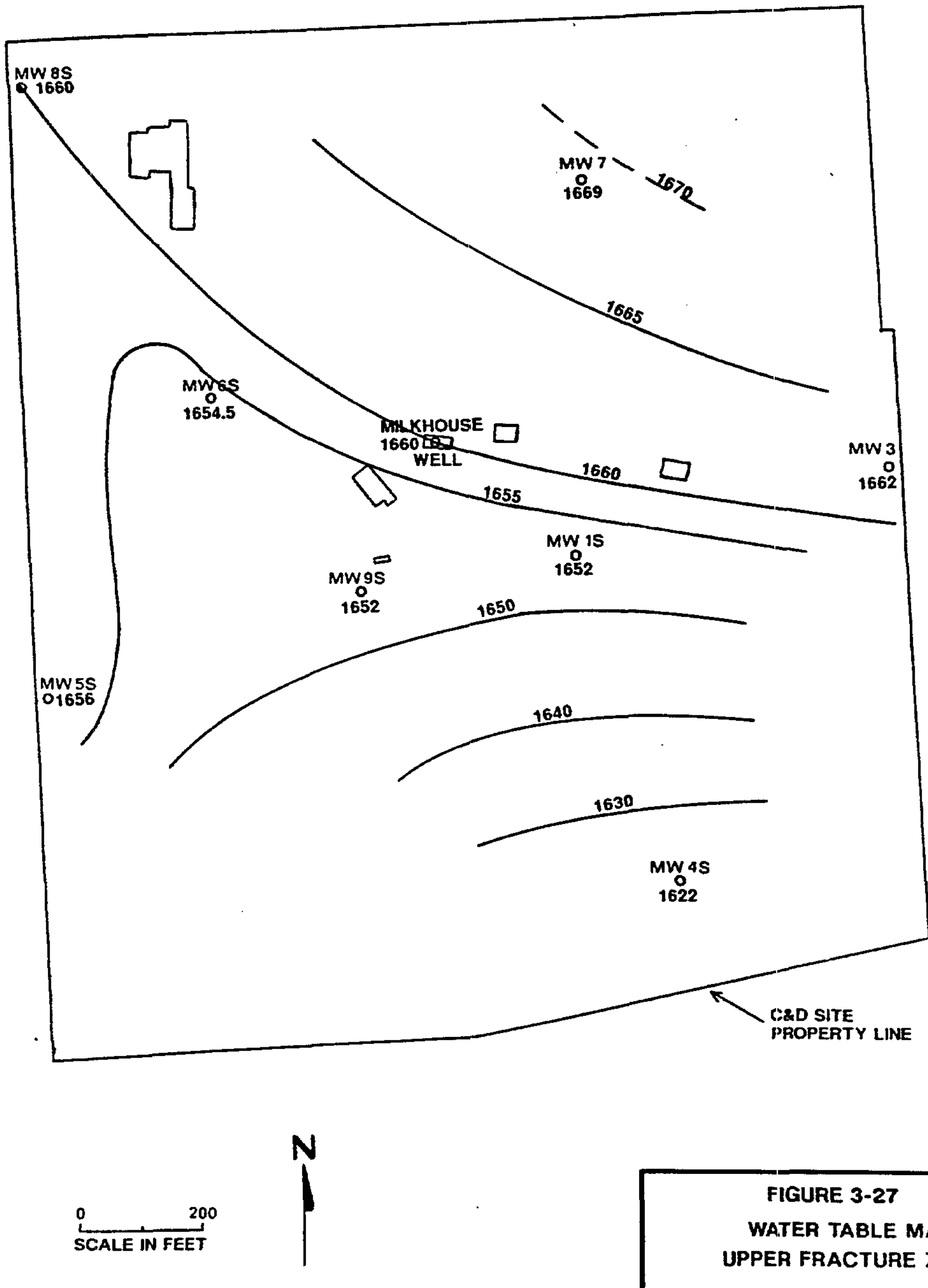
SCALE Noted
DATE May 1991
FIGURE 3-26

160988

AR312975

This figure shows a number of the monitoring wells including their screened intervals relative to the fracture zones referred to above. The figure also shows the maximum and minimum water levels measured in these wells for the period June 1989 to May 1990. The reason that the artesian well (Figure 3-7) flows at the surface during certain times of the year (Table 3-33) becomes apparent in the cross section. During dry periods the potentiometric surface of groundwater in the upper aquifer remains below the land surface. During periods of high recharge to this aquifer, however, the potentiometric surface rises so that it is actually above the land surface in certain areas as shown in the cross section for June 26, 1989. Water will flow from any well that taps an aquifer whose potentiometric surface is higher than the land surface. The artesian well was flowing on June 26, 1989 whereas it was not flowing on September 13, 1989.

3.7.4.2 <u>Groundwater Flow</u>. In the upper fracture zone the groundwater is recharged by precipitation that infiltrates through the weathered bedrock from the surface of the Site and in the higher elevation areas to the northeast. Evidence to support this can be found in Figure 3-24 which shows daily fluctuations in water levels for MW-6S with respect to precipitation. The water level peaks are indicative of recharge from precipitation. As mentioned in the previous section, the size and frequency of fractures is fairly consistent as indicated by the similarity in hydraulic conductivity values for the shallow wells. Furthermore, this is supported by information obtained from rock cores. As a result, it is possible to determine the direction of groundwater flow in this zone by plotting the water levels on a map and contouring the elevations. Figures 3-27 through 3-38 present water table contour maps for June 1989 through May 1990. The contours connect the points of equal elevation of the water table. The general direction of flow is perpendicular to the contours



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

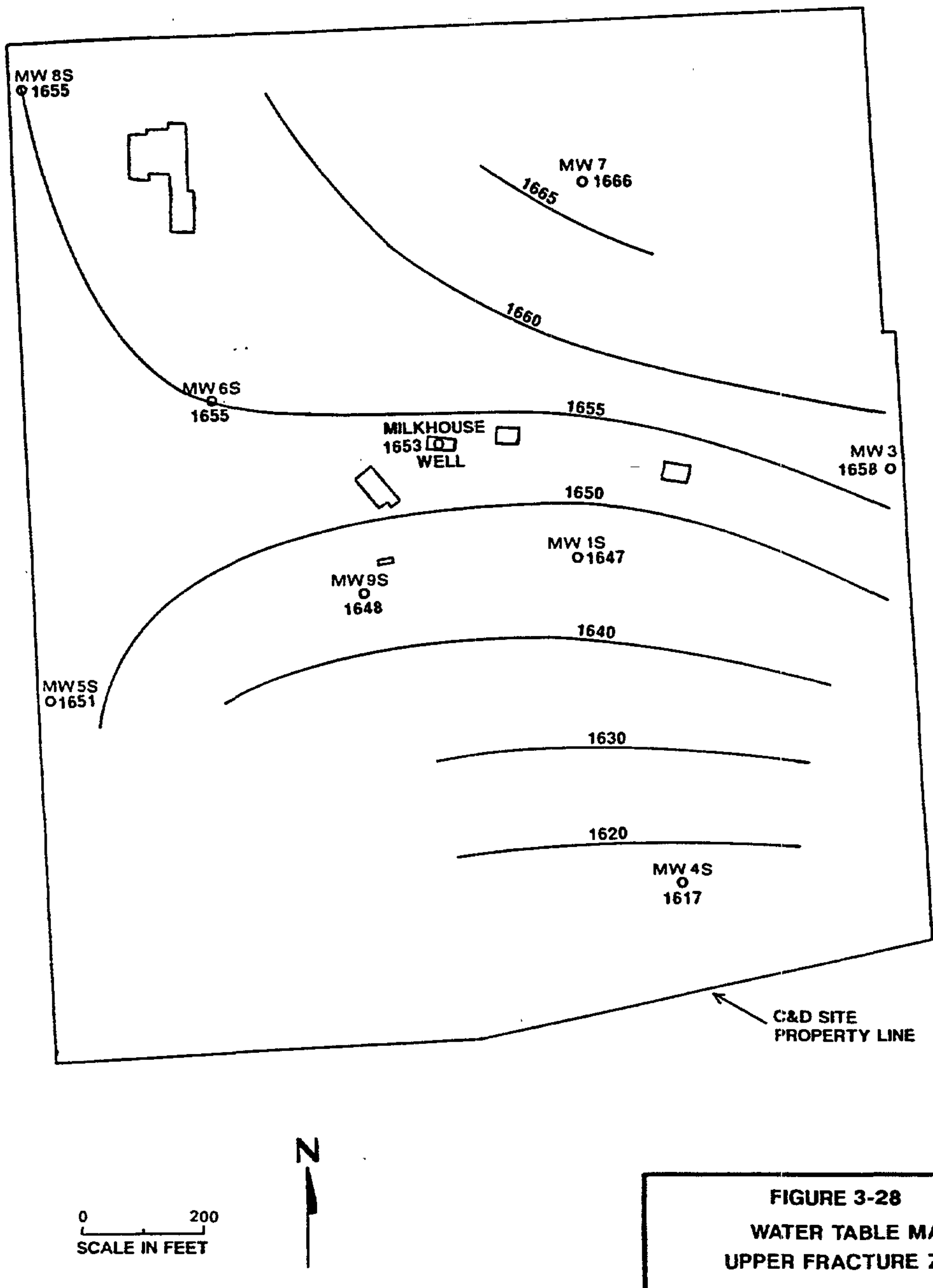
FIGURE 3-27

WATER TABLE MAP
UPPER FRACTURE ZONE

JUNE 19, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

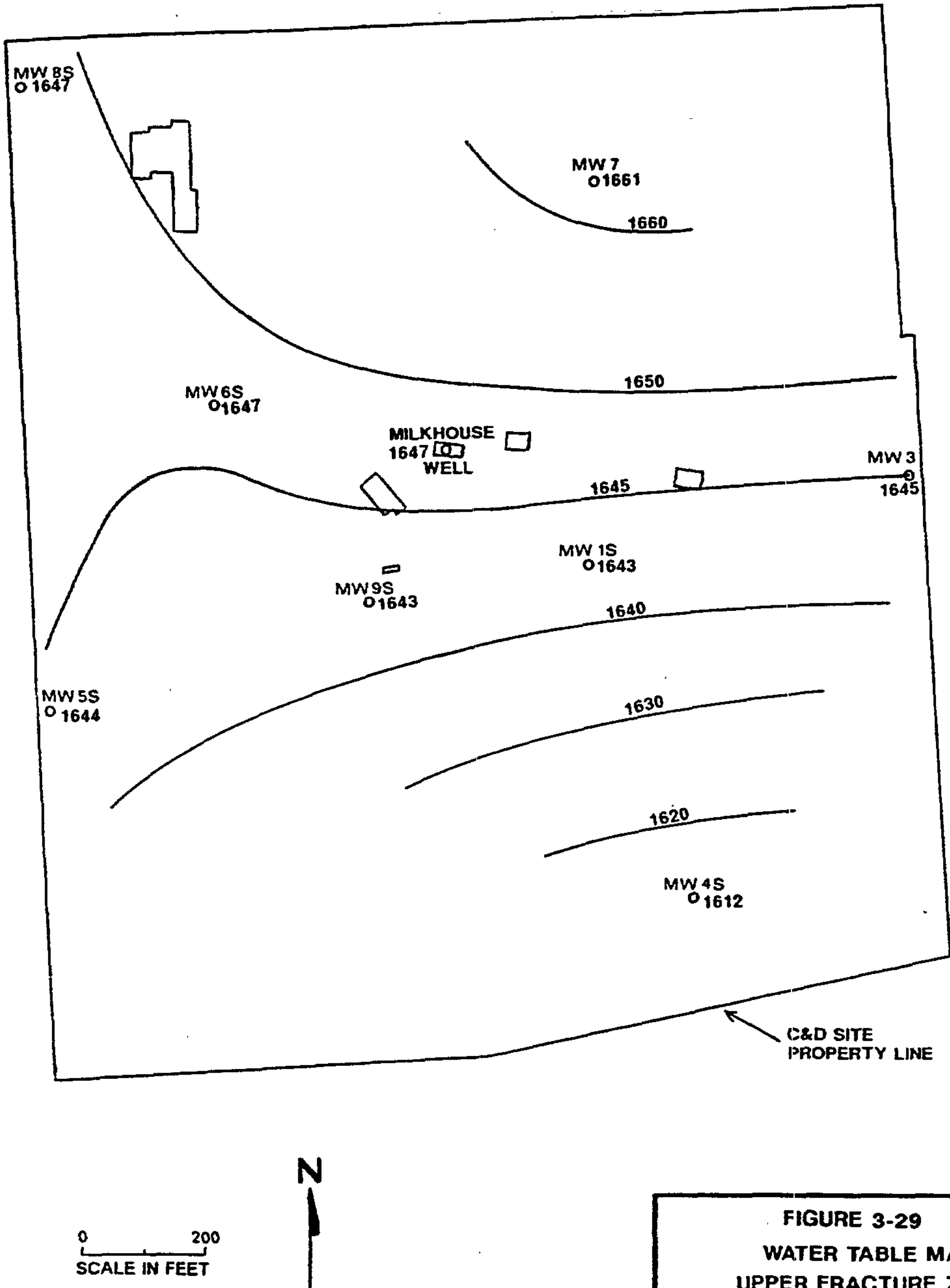
FIGURE 3-28

WATER TABLE MAP
UPPER FRACTURE ZONE

JULY 11, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

FIGURE 3-29

WATER TABLE MAP
UPPER FRACTURE ZONE

AUGUST 15, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

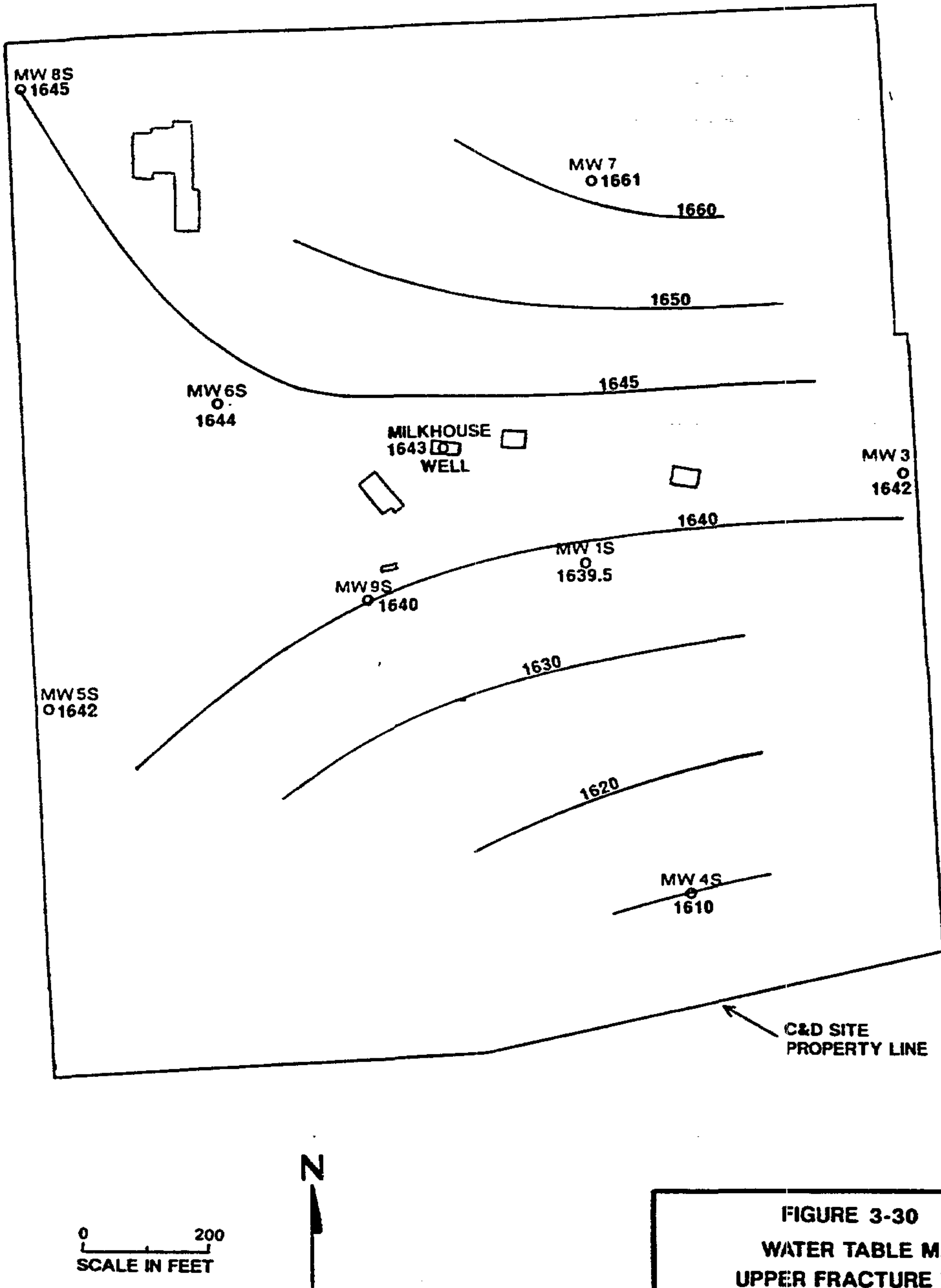


FIGURE 3-30
WATER TABLE MAP
UPPER FRACTURE ZONE
SEPTEMBER 13, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

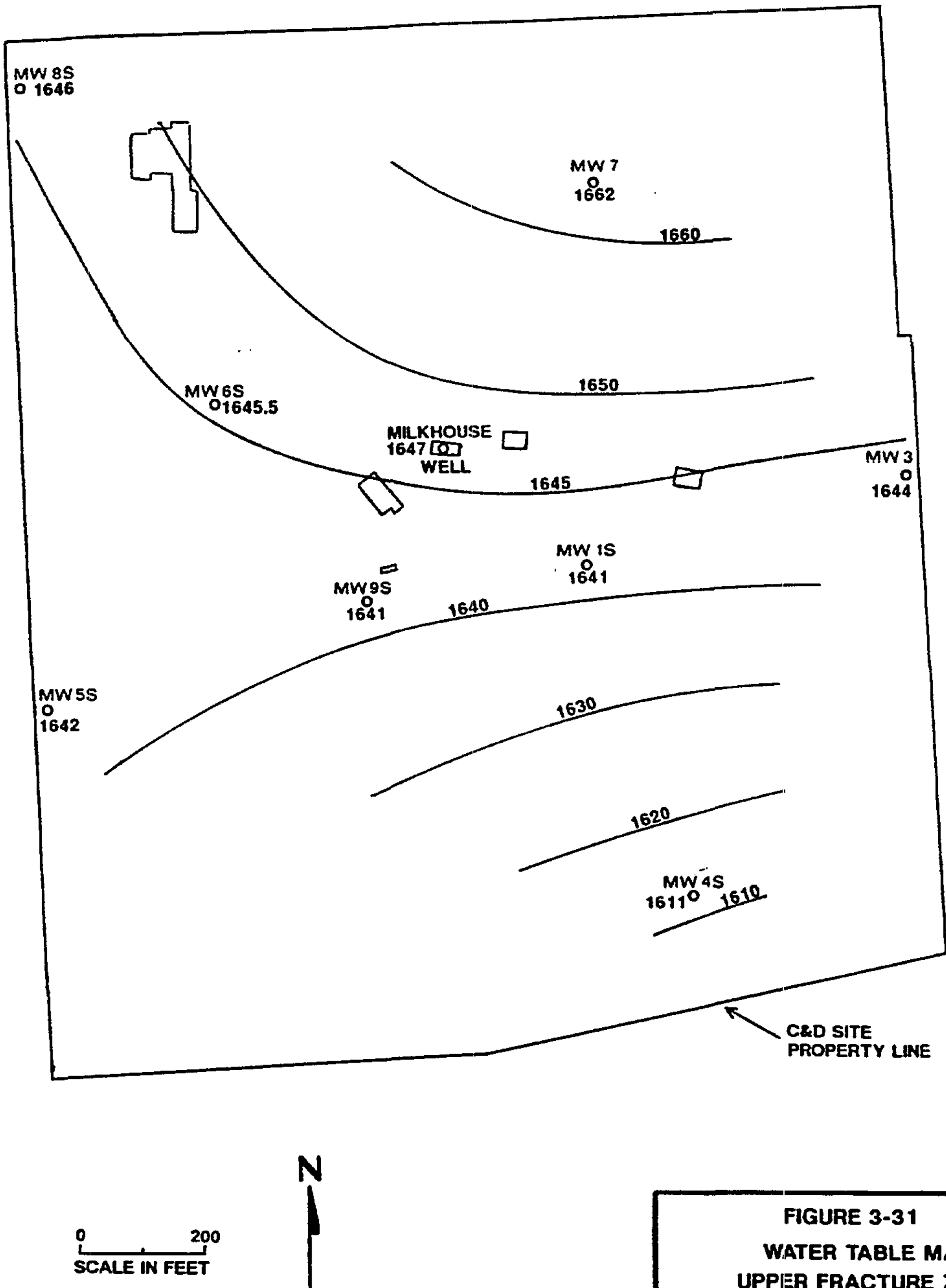


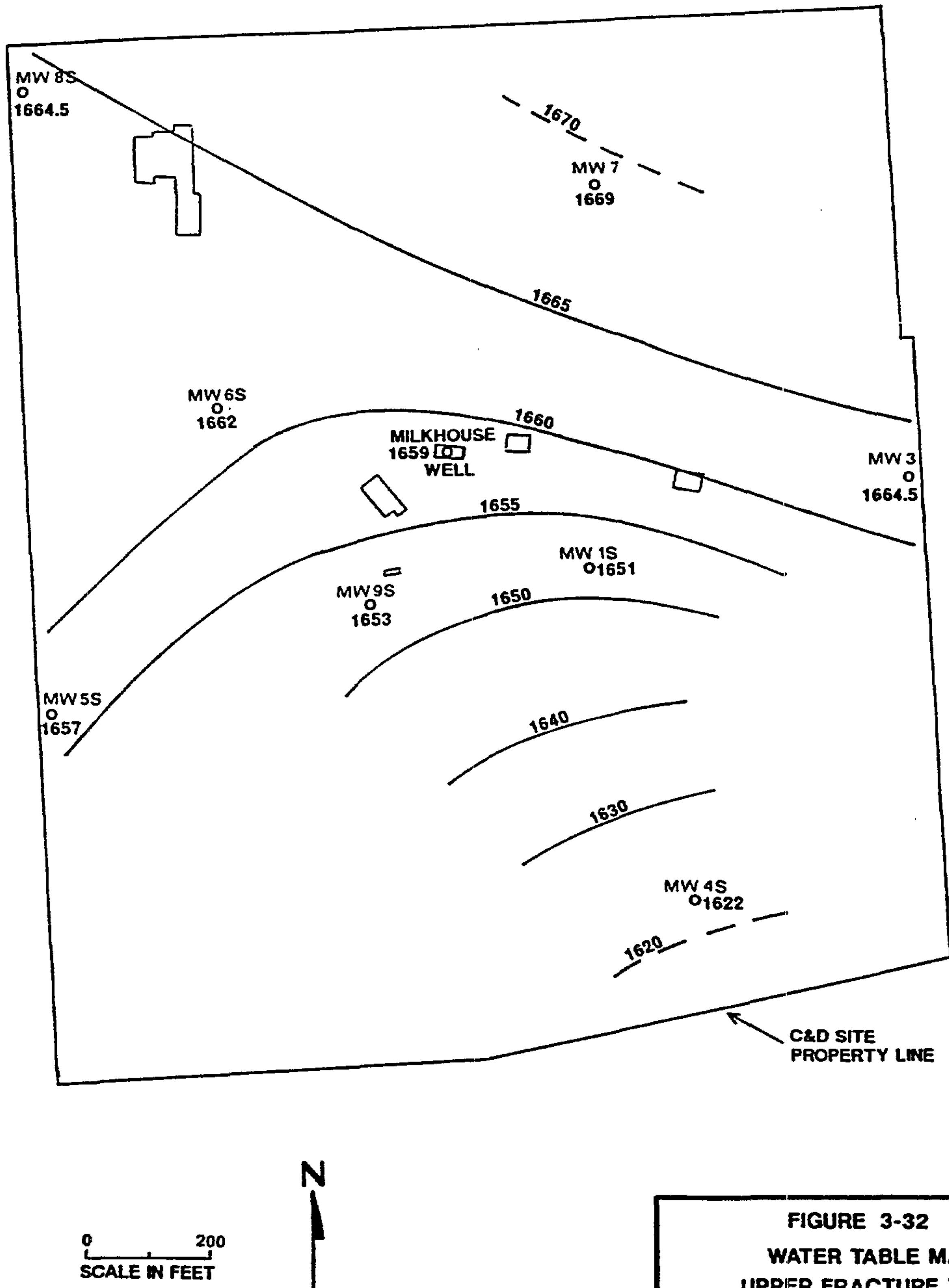
FIGURE 3-31
WATER TABLE MAP
UPPER FRACTURE ZONE
OCTOBER 18, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

FIGURE 3-32
WATER TABLE MAP
UPPER FRACTURE ZONE
NOVEMBER 21, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

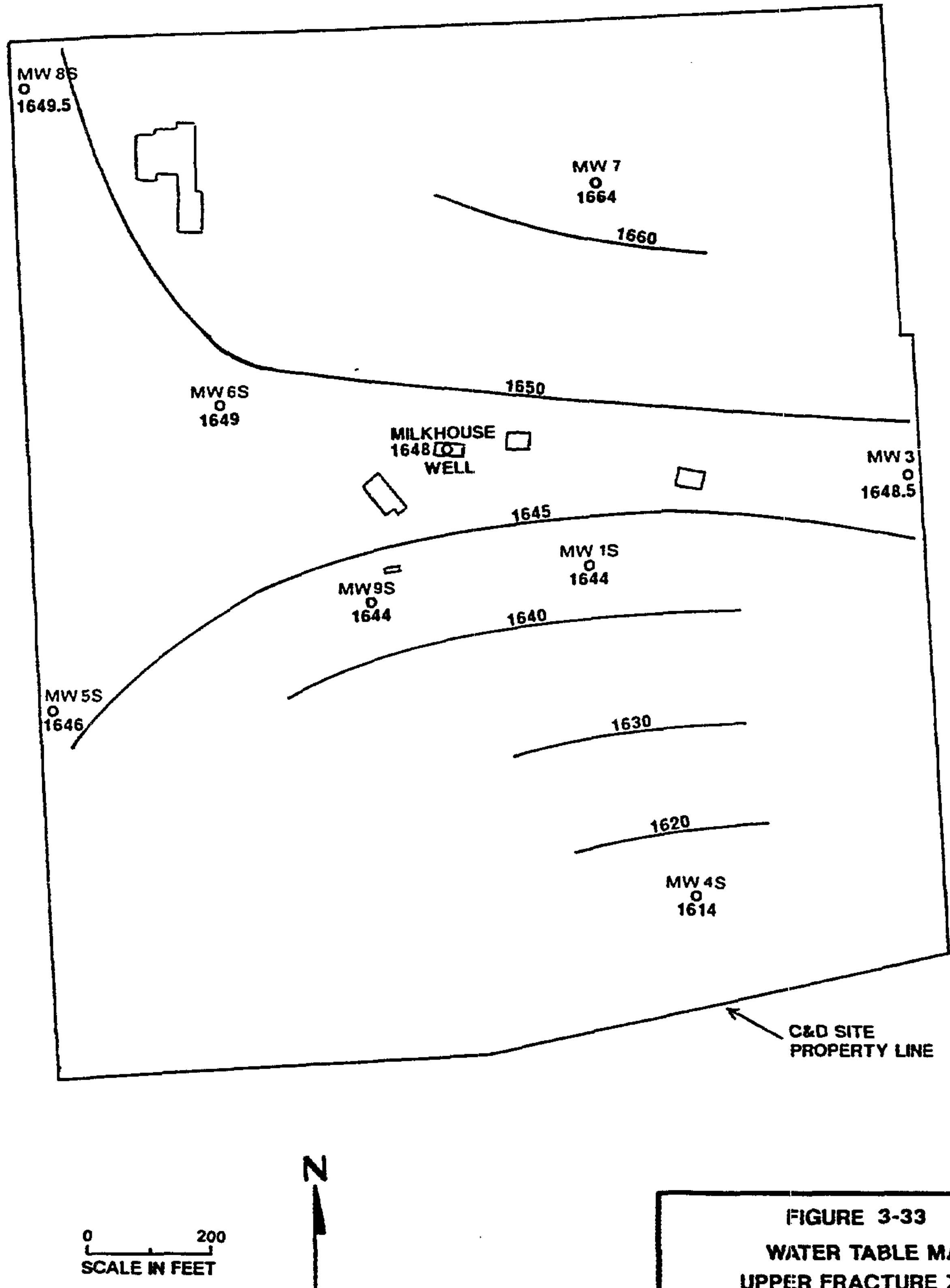


FIGURE 3-33

WATER TABLE MAP
UPPER FRACTURE ZONE

DECEMBER 19, 1989

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

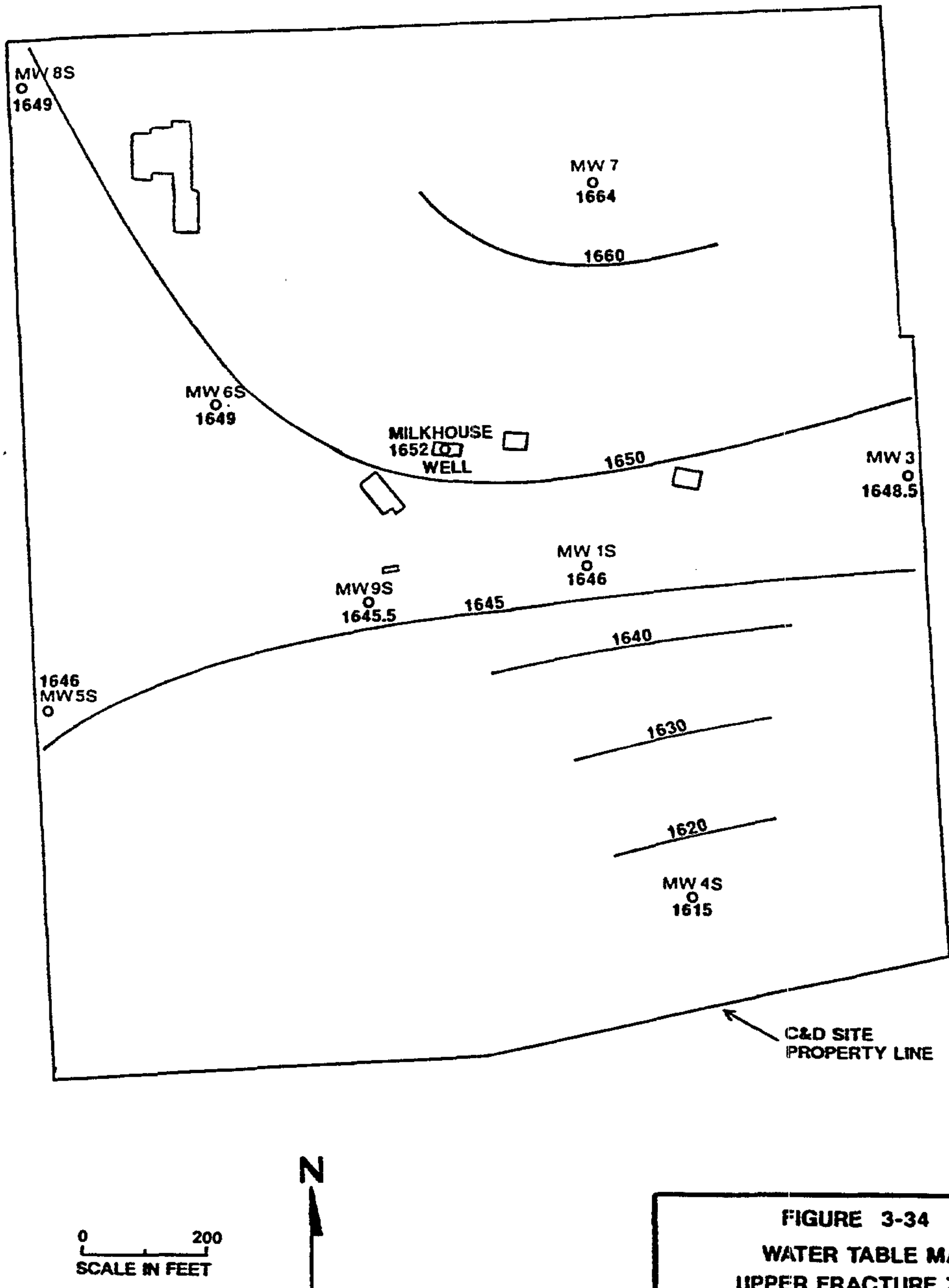


FIGURE 3-34

WATER TABLE MAP

UPPER FRACTURE ZONE

JANUARY 11, 1990

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

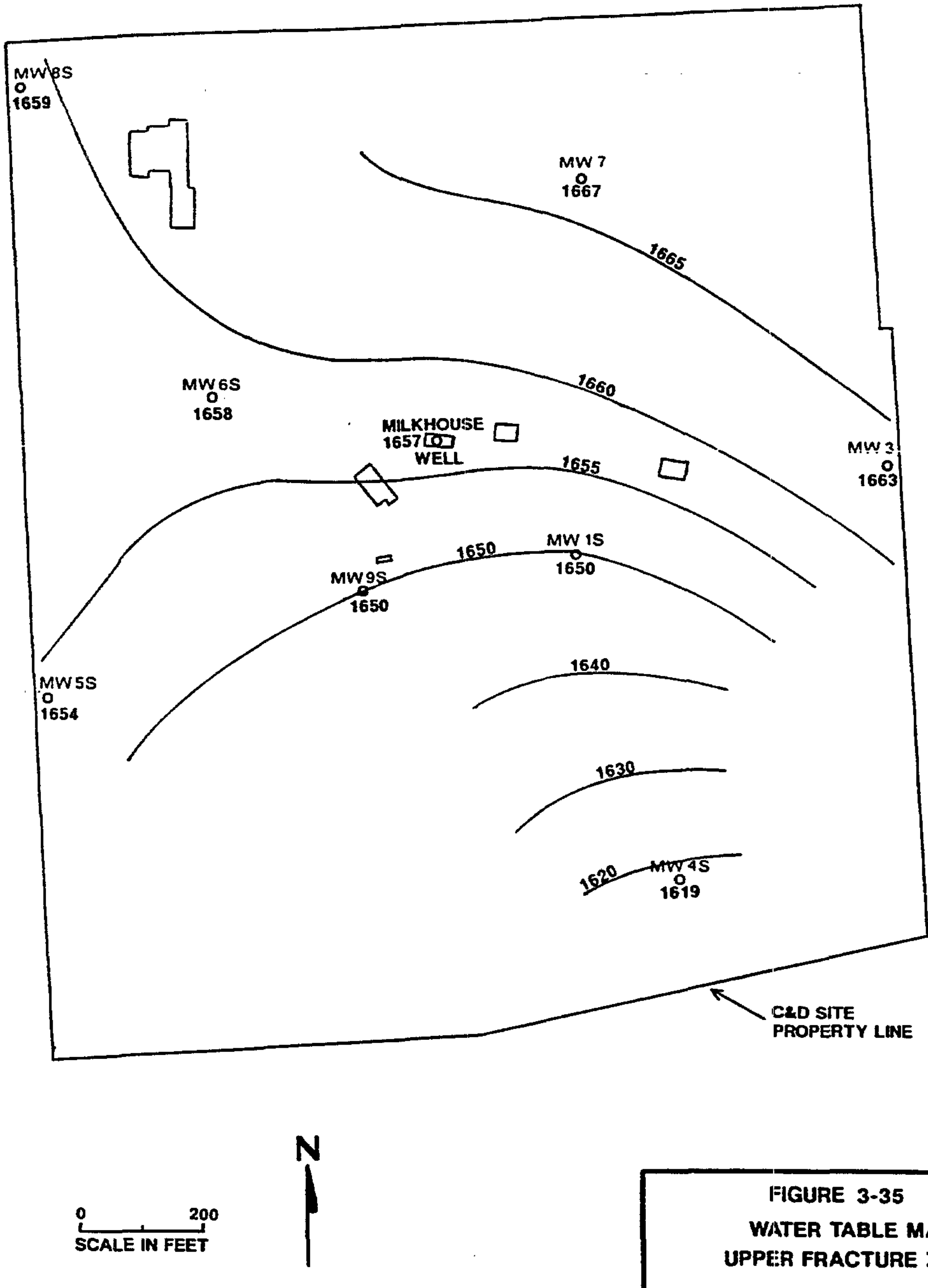


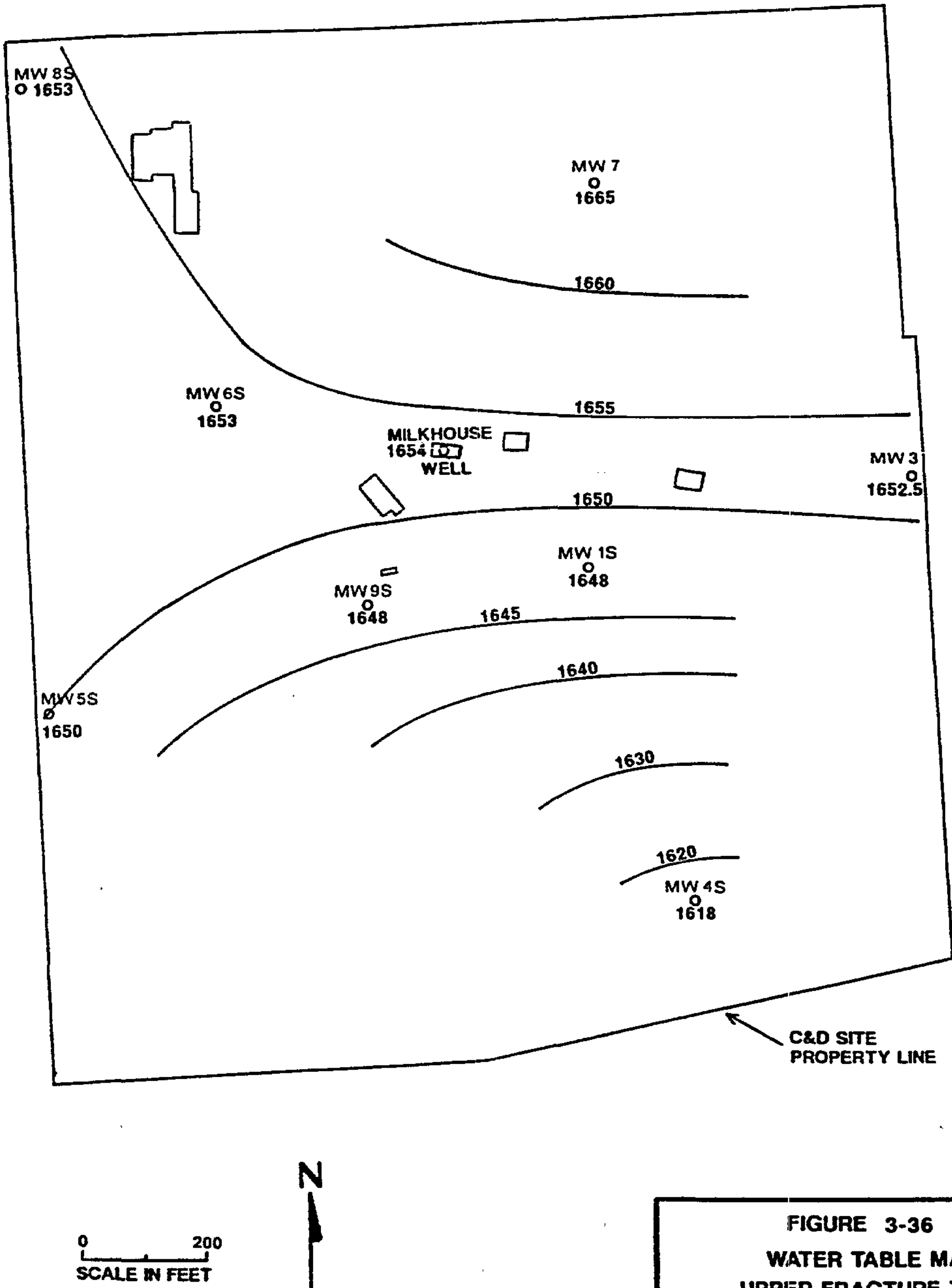
FIGURE 3-35
WATER TABLE MAP
UPPER FRACTURE ZONE
FEBRUARY 15, 1990

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

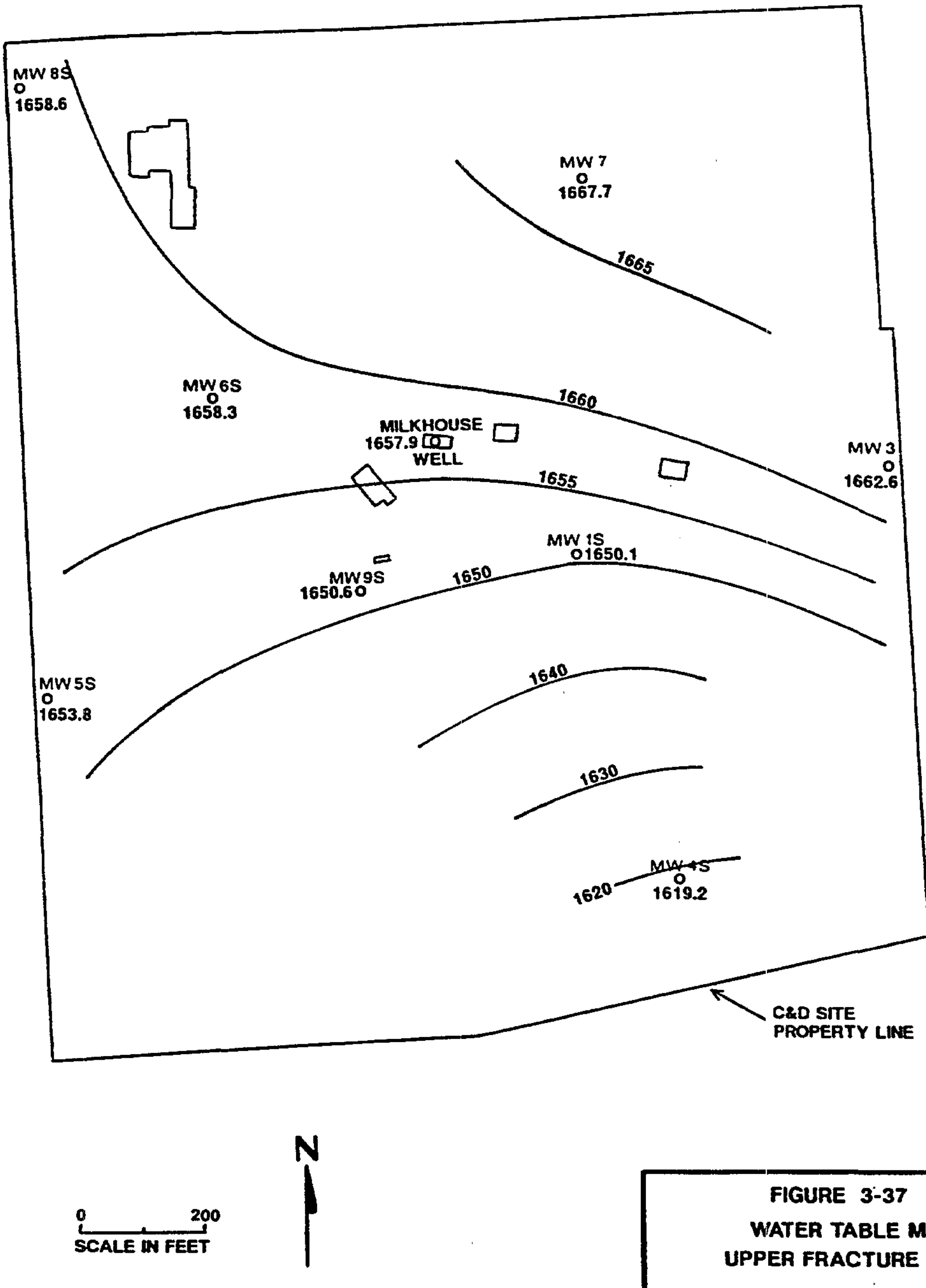
FIGURE 3-36

WATER TABLE MAP
UPPER FRACTURE ZONE

MARCH 19, 1990

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.



CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

FIGURE 3-37

WATER TABLE MAP

UPPER FRACTURE ZONE

APRIL 11, 1990

C&D RECYCLING SITE REMEDIAL INVESTIGATION

LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

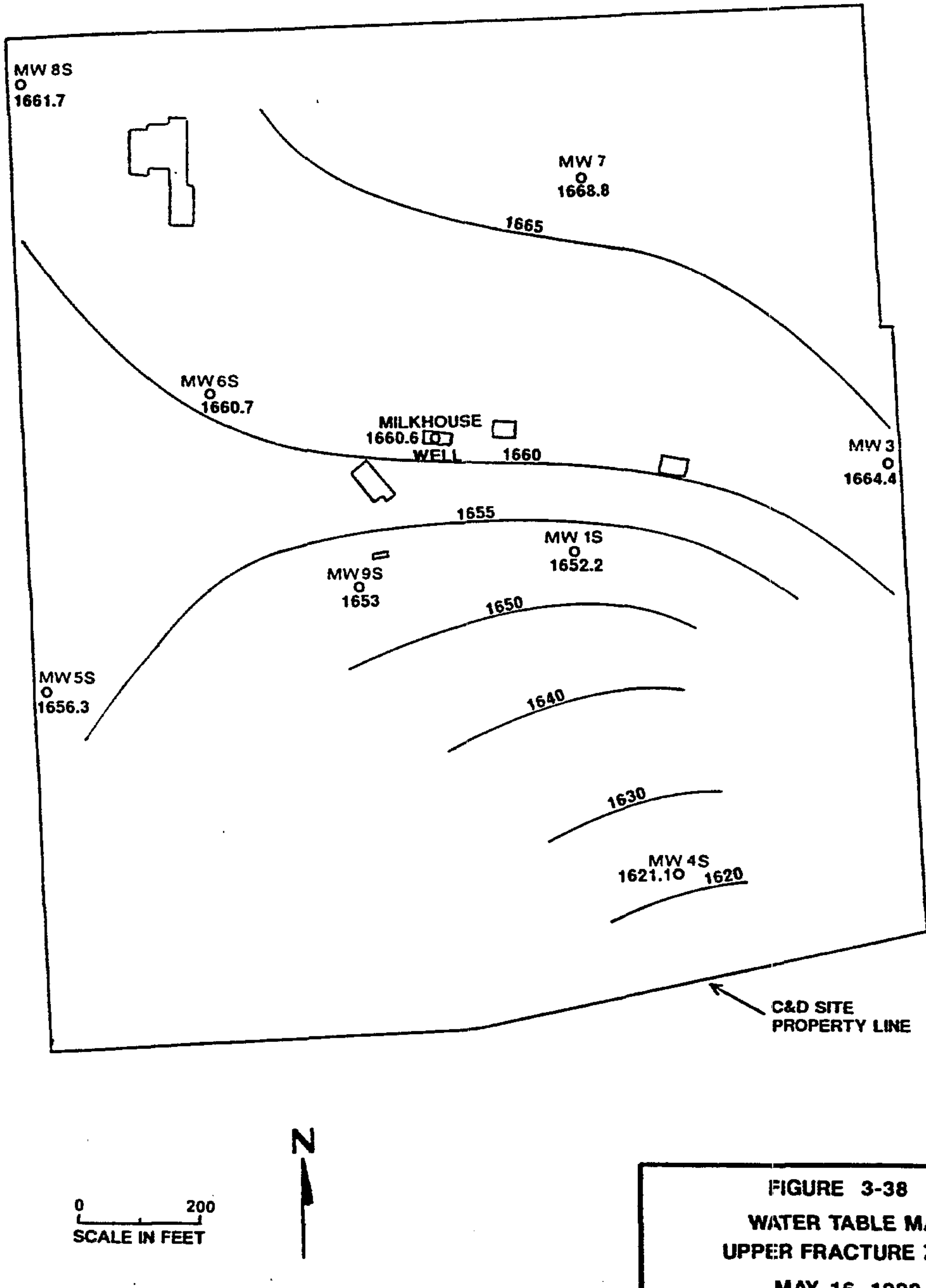


FIGURE 3-38
WATER TABLE MAP
UPPER FRACTURE ZONE
MAY 16, 1990

C&D RECYCLING SITE REMEDIAL INVESTIGATION
LUZERNE COUNTY, PA

FRED C. HART ASSOCIATES, INC.

CONTOURS ARE IN FEET ABOVE MEAN SEA LEVEL

CONTOURS BASED ON INFORMATION FROM WELLS SHOWN

toward the lower elevations. Since flow in this aquifer is primarily through fractures, the actual, small scale flow directions will be aligned with the horizontal and vertical fractures. However, due to the large number of fractures in this zone, flow on a larger scale will be perpendicular to the contours shown. For all twelve months groundwater flow in the upper fracture zone (Figures 3-27 through 3-38) is toward the southwest in the northern portion of the Site and then south toward Mill Hopper Creek. This is a common pattern for flow in a shallow unconfined aquifer in that the contours are a subdued reflection of the topography and the flow is toward a surface water discharge point. The surface water elevation of the pond was consistently the lowest, shallow water elevation during the measurement period. The monitoring well located closest to the pond, MW-4S, exhibits at least a five foot higher groundwater elevation than the surface water level in the pond. This indicates the pond and Mill Hopper Creek are discharge points not only for surface water runoff but also for groundwater from the shallow aquifer.

Although the fate of shallow groundwater in the northwestern portion of the Site is unclear due to the lack of off-site water level information, it is possible that shallow groundwater in this area flows west-northwest similar to the surface water pattern (see Figure 2-3). This interpretation is based on a comparison of water level gradients between MW-8S and MW-5S, versus MW-8S and Pond Creek to the northwest.

Groundwater flow in the deep fracture zone (elevations 1440 to 1460 feet AMSL) can not be determined based on the information collected. Unlike the upper fracture zone, the deep zone contains fewer fractures that are not well connected. In addition, fractures at this depth are narrower due to the weight of the overlying rock and overburden. For every foot of depth, the overburden pressure is approximately 1 PSI (Driscoll, 1986). Below about 300 feet fractures in bedrock are generally so narrow that groundwater flow through them is virtually eliminated.

Along the northern boundary of the Site there is minimal groundwater flow in the deep zone. At MW-8D2, no major fractures were encountered in this zone and the well is nonproductive even though the screened interval in this well was increased from 15 feet to 30 feet. At MW-2, some fractures were noted at depth, however; packer testing of these zones indicated that they were nonproductive.

In the central portion of the Site, monitoring wells MW-6D and MW-1D have nearly identical water levels with the level in MW-1D consistently higher by about one half foot (Figure 3-22). There is, therefore, a hydraulic connection between these two monitoring wells. In both cases water levels in the deep zone are approximately 100 feet below their shallow counterpart.

In the southern portion of the Site, MW-5D taps the same deep zone as MW-1D and MW-6D, but no connection appears to exist based upon the measured water levels. Figure 3-23 is a water level graph of all three deep wells. As mentioned in Section 3.7.4 water level information for MW-5D prior to the August measurement actually shows the recovery curve of this well in response to the hydraulic conductivity test pumping which was conducted in late June, 1989. Measurements from August 1989 through May 1990 appear to reflect the potentiometric surface for the screened interval. In viewing the high water levels in MW-5D there was an initial fear that there may have been an incomplete seal between the upper and lower zones in this well which resulted in the higher water levels observed. However, this is highly doubtful. Any water that seeps down along the outside of the casing would encounter bentonite grout at the base of the surface casing. This grout extends approximately 184 feet down to the top of the bentonite pellet seal which is over three feet thick. Since the bentonite grout was tremied into the wells in slurry form the grout tends to flow into and seal fractures that intersect the borehole walls. The more likely cause for the observed water levels in MW-5D is slow leakage from the upper aquifer through vertical fractures in this area.

Evidence for this can be seen in Figure 2-7 which outlines the drainage patterns in the Site vicinity. As indicated in that section, these patterns often reflect large scale vertical fractures. The linearity and orientation of Mill Hopper Creek suggests that it is underlain by a vertical extension fracture which, if extended slightly, would be in close proximity to the MW-5 well cluster. The observed levels in MW-5D are probably a combination of the head values in the upper and lower aquifers in this area.

In general, the deep well graphs show the same steady decline in water levels as was seen in the shallow wells, but at a faster rate. From early July to October the shallow monitoring well water levels declined an average of ten feet. Water levels in both MW-1D and MW-6D, on the other hand, dropped approximately forty feet during the same period. It has also been noted that deep well water levels continued to decline in October while the shallow well water levels began to increase. Further, Figure 3-25 indicates steady daily changes in MW-6D water levels without any noticeable direct influence from precipitation events. These three facts indicate that recharge to the deep zone is from slow leakage from the upper fracture zone near the Site or that the catchment area for this zone is distant from the Site. At this time, given the present data, it is not possible to identify the discharge area for the deep fracture zone.

3.7.5 <u>On-Site Groundwater Sampling Procedures</u>. A total of five rounds of groundwater sampling were conducted at the Site since field work was initiated in 1988. The purpose of monitoring well sampling and analysis are summarized as follows:

1) To evaluate the quality of groundwater within the Site boundaries;

2) To determine if organic compounds and/or inorganic constituents related to past or current conditions at the Site have migrated to groundwater;

3) To determine if any organic compounds and/or inorganic constituents in groundwater samples obtained from the monitoring wells are present in concentrations that exceed applicable groundwater standards;

APPENDIX 6E
IN-SITU HYDRAULIC TESTING

RI Sections 3.7.3, 3.7.3.1, 3.7.3.2 and 3.7.3.3
RI Table 3-31
RI Figure 3-18

The groundwater in most of the monitor wells at the Site cleared during development with the exception of MW-8D, MW-8D2 and MW-5D. MW-8D was later abandoned due to obstructions in the well. MW-8D2 was completely evacuated during development and did not recharge sufficiently for further development. MW-5D recovered very slowly after development. This well was completely purged several times throughout its development resulting in some improvement in water yield.

3.7.3 In Situ Hydraulic Conductivity Testing. The hydraulic conductivity (K) of a rock formation or unconsolidated deposit is defined as its capacity to transmit water. K is governed by the size and shape of the pore spaces or fractures in a material, the effectiveness of the interconnection between the pores or fractures, and the physical properties of the water moving through it. If the pores or fractures are not well connected the volume of water passing through the material is restricted and the resulting hydraulic conductivity is low. On the other hand, if the interconnections are large relative to the pores, the hydraulic conductivity will be high (Driscoll, 1986).

Groundwater flow in the Mauch Chunk beneath the Site is primarily through the horizontal and vertical fractures. Although the literature states that the Mauch Chunk contains sandstone beds that exhibit good primary permeability, the rock coring program at the Site indicated the sandstone beds tended to be well cemented with silica or carbonates resulting in very low or no primary permeability. Therefore, groundwater would not be expected to readily migrate in the zones.

Borehole tests to determine hydraulic conductivity values were performed on 13 of 14 monitoring wells at the Site. Reportable results were obtained for 11 of the 13 monitoring wells tested. The testing methodology, analysis, and results are provided in this section. Raw data, recovery curves, and equation used are provided in Appendix G.

3.7.3.1 Test Methodology. The method used to obtain information for the determination of hydraulic conductivity was a modified form of the slug test. In a slug test, the static water level is measured in a monitoring well. A known volume of water is then either injected or removed instantaneously. The resulting water level is then monitored over time until the water level in the monitoring well returns to the original static level. Subsequent analysis of this information by either graphic or numerical methods allows the estimation of the hydraulic conductivity for the material in the vicinity of the monitoring well.

The testing method used at the Site was essentially the same as a slug test except that instead of quickly removing a volume of water, the monitoring wells were pumped for periods up to one hour. These individual monitoring well pumping tests were considered to be more accurate than strict slug tests because a greater stress was placed on the aquifer being tested and because the borehole effects caused by the large sand packs around the screens (an inherent problem with a strict instantaneous slug test) were reduced.

It must also be pointed out that slug test methods were designed for use in aquifers exhibiting primary permeability in homogeneous, isotropic material. Such is not the case at the Site where secondary permeability dominates. By pumping the wells instead of removing a small volume of water the effects of the test are projected into the fractures at a much greater distance from the monitoring well. When the pumping is stopped, the rate at which the water level returns (recovery) to the static level is determined by the ability of the water in the fractures to move toward the monitoring well. Since pumping the monitoring well affects a larger area the results obtained more accurately reflect the hydraulic conductivity for the formation as a whole in the vicinity of the monitoring well.

As in any test of this type, the results can not be considered truly quantitative, since ideal conditions seldom occur in nature. In addition, there are no short term pumping or slug test methodologies available for use in monitoring wells completed in fractured bedrock. The hydraulic conductivity results presented here are probably accurate to within an order of magnitude; however, the true worth of these results is how they compare to each other and what that comparison indicates about the ability of water to move in the Mauch Chunk beneath the Site.

3.7.3.2 Procedure. Prior to the initiation of pumping, the static water level was measured in all nearby monitoring wells and the monitoring well to be tested. Measurements were made by means of an electronic water level detector. All data were recorded. The water level detector was then left in the monitoring well to be tested. Pumping then began using the WaTerra inertial pumping system. The time at which pumping began was recorded. Water discharged from the pump was collected in a 5 gallon bucket. Total volume discharged over time was recorded in order to determine both periodic and overall average discharge rates. Drawdown was monitored during pumping by using the water level recorder in the monitoring well being pumped. Periodic measurements were made in nearby monitoring wells which served as observation wells. Pumping continued until the monitoring well was fully evacuated or the drawdown stabilized. When one of those two conditions was reached, the pump was shut off and the WaTerra tubing was immediately pulled from the monitoring well. Recovery of the water level was then monitored and recorded until the static water level was reached. In some cases where recovery was extremely slow, measurements were obtained hours or days later in order to develop the recovery curve. Data collected for each well are summarized in Table 3-31. Recovery data were plotted as drawdown vs. elapsed time on semi-log graph paper to produce the recovery curve needed for analysis. The Bouwer and Rice (1976) method of analysis was used to develop the hydraulic conductivity value.

3.7.3.3 Results. The hydraulic conductivity values developed from the data obtained during individual monitoring well tests are shown in Table 3-31, and are plotted on a logarithmic scale in Figure 3-18. No test was performed on monitoring well MW-8D2 since this well was nonproductive. Tests on MW-4S and MW-9S did not yield usable results because in both cases the recovery was too rapid to allow collection of sufficient data for analysis. Hydraulic conductivity values for these two monitoring wells were not determined. However, since recovery in these two monitoring wells was so rapid, the screened intervals exhibit a higher hydraulic conductivity than the intervals screened in the other monitoring wells. In the case of MW-4S, the screened interval is very near the surface where bedrock weathering has increased the size and number of fractures resulting in a higher K value. The screened interval in MW-9S also contains a large number of open fractures based on information collected during the drilling of nearby corehole C-C.

As noted in the previous section, water levels were monitored in monitoring wells near to those being tested. The only locations at which a nearby monitoring well showed a measurable drawdown was MW-9S during pumping at MW-9M, and MW-9M during pumping at MW-9S. In both cases the drawdown was measured at 2 inches, and recovery was immediate as soon as pumping was discontinued. The response of the monitoring wells to this short term pumping suggests that the fracture zones screened in MW-9S and MW-9M are well connected. Pumping at all three deep well locations had no effect on any shallow well indicating that the deep fracture zone and shallow fracture zone are not well connected.

Figure 3-18 also indicates that all shallow monitoring wells tap a well developed fracture zone. Except for MW-5S, the hydraulic conductivity values for all shallow wells for which usable results were obtained fall within one order of magnitude. This indicates that the size and frequency of fractures within this zone (1560 ft. to 1660 ft. AMSL) are fairly consistent beneath the Site.

Table 3-31

Summary of In Situ Hydraulic Conductivity Data
C & D Recycling Site Remedial Investigation

Monitoring Conductivity* Well	Total Pumping Time (min)	Total Volume Removed (gal)	Average Discharge Rate (gal/min)	Maximum Drawdown (feet)	Total Recovery Time (min)	Hydraulic (feet/day)
MW-1S	47	180	3.83	8.5	52	0.15
MW-1D	53.3	88.5	1.66	13.7	242	0.018
MW-3	35	111	3.17	29	20	0.65
MW-4S	23.5	40	1.70	0.45	2.5	— (1)
MW-5S	8.3	12.5	1.50	60	365	0.01
MW-5M	17.5	60	3.43	15	31	0.32
MW-5D	10.8	15.5	1.43	93	>2860	0.00028
MW-6S	12.6	10	0.80	22	34	0.16
MW-6D	25	24	0.96	20	36	0.75
MW-7	25.1	80	3.19	10.3	31	1.26
MW-8S	11.5	28.5	2.48	24	22	0.71
MW-9S	44.5	140	3.15	0.5	<0.2	— (2)
MW-9M	60	214	3.57	3	10	0.66

*Bouwer and Rice Method (1976). Qualitative only, see text.

1. Result not considered valid because of poor curve from insufficient data as a result of rapid recovery.

2. Recovery in MW-9S following pump shutoff was instantaneous. A slug injection test was attempted. No measureable elevation above static immediately following injection. Very high K.

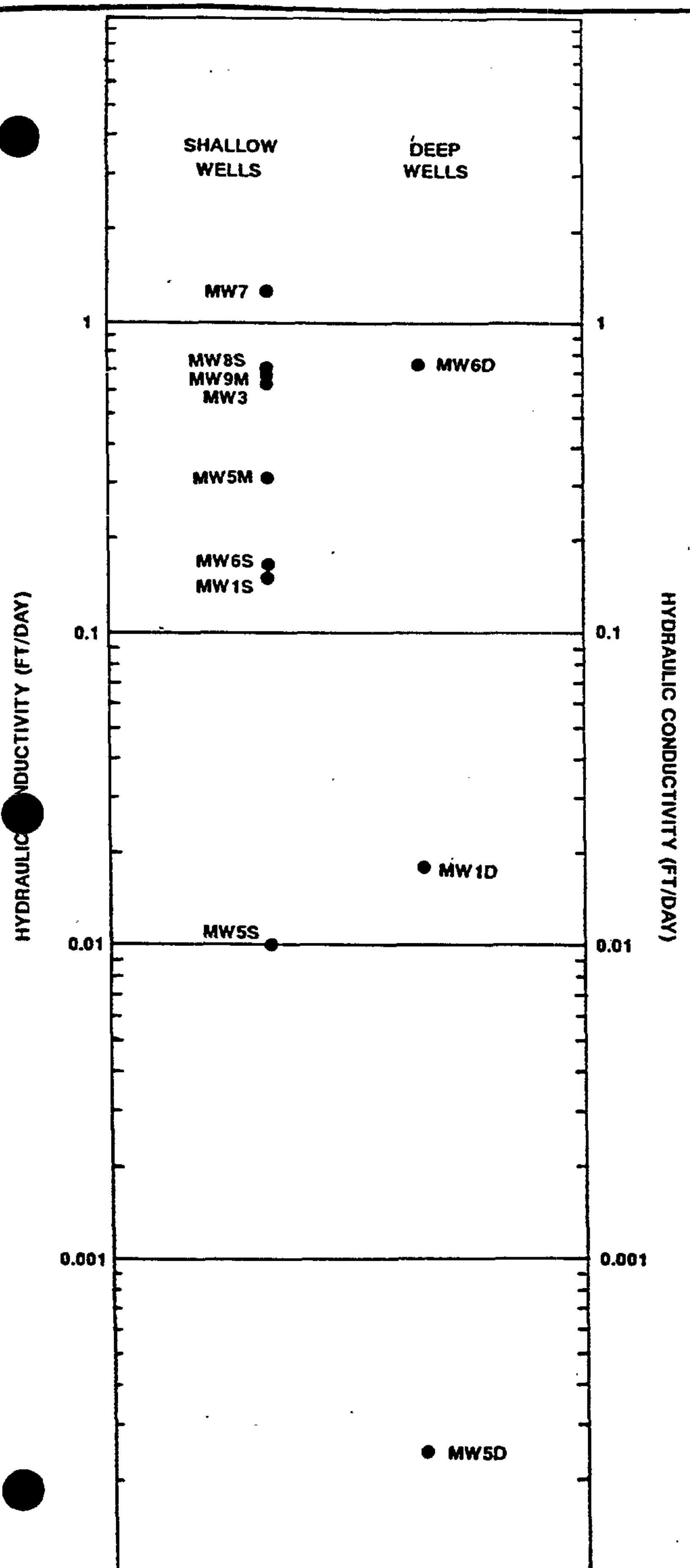


FIGURE 3-18

HYDRAULIC CONDUCTIVITY RESULTS ON-SITE MONITORING WELLS

C&D RECYCLING SITE
REMEDIAL INVESTIGATION

FRED C. HART ASSOCIATES, INC.

The deep monitoring wells, on the other hand, show a wide range in hydraulic conductivity values, from 2.8×10^{-4} to 0.75 ft/day. One other deep well on-site, MW-8D2, is nonproductive. These 4 wells all tap zones between 1437 and 1467 ft. (AMSL). It is apparent that fractures in this zone are fewer in number, less well developed, probably smaller in width due to the weight of the overlying rock and are less likely to be interconnected. This conclusion is supported by information in the core logs (Appendix D) which indicate numerous closely spaced fractures near the surface. The number of fractures then decreased in the deeper cores and fewer of these lower fractures produced water except for those identified in the lower fracture zone (see Section 3.7.1--Packer Testing). The lack of water in horizontal fractures between the two zones may be due to lack of interconnection between them and/or a lack of vertical fractures in these areas. Fractures in the lower zone, though fewer in number, may have somewhat better interconnection and may intersect the regional large scale vertical fractures (see Section 2.6.1--Fractures and Groundwater Movement). This will be more fully discussed in the next section.

3.7.4 Groundwater Elevation and Flow. Groundwater flows in response to differences in pressure within an aquifer--from areas of higher pressure toward areas of lower pressure. The amount of pressure in any part of an aquifer is reflected by the height to which water rises within a well that taps that point. To determine the direction of groundwater flow, the elevation of the groundwater must be known at a minimum of three different points within the same aquifer. The term aquifer as used here means the rock or unconsolidated deposits are permeable to some extent so that water is able to move either through the primary pore spaces or through secondary fractures or solution pathways. This is an important point with regard to the Site because as noted in the previous section (3.7.3) more than one aquifer is present in the rocks underlying the Site. Groundwater flow directions must therefore be determined using water

APPENDIX 6F
PACKER TESTING

RI Section 3.7.1
RI Figure 3-17
RI Tables 3-25 and 3-26

3.7 Groundwater Investigations

The most extensive program conducted at the Site involved work related to groundwater investigations. This program included packer testing, monitor well installation, several rounds of groundwater sampling both on-site and off-site, in situ hydraulic conductivity testing and groundwater elevation and flow measurements. The following sections describe the components of the groundwater investigation conducted at the Site.

3.7.1 Packer Testing. Packer testing was conducted during the 1988 and 1989 field seasons. Stratigraphic intervals were selected based on information obtained from geophysical logs of existing boreholes, rock cores and drilling new boreholes. The criteria used to select specific intervals can be found in the Interim Data Evaluation Report (HART, 1988) and Addendum (HART, 1989). The purpose of packer testing was to obtain groundwater samples from discrete intervals of the bedrock to assess the interval as a groundwater producer and to analyze the samples for copper and lead. Copper and lead were chosen as analytical parameters since these metals were the most predominant constituents identified in previous soil sampling efforts at concentrations that could be distinguished from expected background levels.

The packer assembly consists of two rubber packers that can be expanded to a minimum diameter of six inches, a four inch diameter, ten-foot long stainless steel Johnson well screen with a Geotech bladder pump and a QED purge pump. The total distance between the two packers is eleven feet. The Geotech bladder pump is 1.75 inches in diameter and two feet long. The bladder pump was used to collect interval groundwater samples for analysis. The pumping rate for this pump was approximately 0.5 GPM but varied with depth and hydrostatic pressure. The purge pump is an air powered piston pump, 1.75 inches in diameter and five feet long. This purge pump was used to purge the selected interval prior to sampling. The pumping rate for the purge pump was approximately 2.5 to 3.5 GPM and is also dependent on depth and hydrostatic pressure. Water intakes for both pumps are located six inches above the lower packer.

The bottom of the lower packer is sealed with a steel plug. The bladder and purge pumps are suspended inside of the well screen by two stainless-steel tubes for each pump. These tubes are connected with Swagelock fittings to the gas inlet and sample outlet lines on both pumps. The stainless-steel tubes are in turn connected to a Swagelock threaded cap and fittings that fit into the top of the upper packer. The stainless-steel cap has two holes drilled through the center with fittings on either side for the inlet and outlet lines. The steel cap is designed and machined to ensure a gas tight fit for the air and sampling lines. Teflon sampling and polyethylene air lines extend from the cap to the ground surface. These lines are half-inch ID and are manufactured in standard lengths of 100 feet. The 100 foot lengths are connected by half-inch teflon compression fittings. The bladder pump and purge pump are operated from the surface with compressed air or nitrogen and a Geotech logic unit. The entire assembly is lowered up and down the borehole on steel cables. A diagram of the packer assembly is presented in Figure 3-17.

Once an interval was selected, the packer assembly was lowered into the borehole using a drill rig. A complete interval volume of water was removed with the purge pump and allowed to recharge. Generally, a period of thirty minutes was allowed for the interval to recharge. If the interval had recovered within that time period, water from the interval was sampled. If the interval had not recovered within thirty minutes, which represents a recharge rate of less than 0.01 gallons per minute, the interval was considered non-productive and not sampled.

After an interval was purged and had recovered, the bladder pump was used for sampling. Water from the teflon sampling line was collected in a Geotech Barrel Filter and field filtered through 0.45 micron cellulose filter paper prior to preservation with nitric acid. Water filtered through the Geotech Barrel Filter was collected in laboratory prepared sample bottles, preserved, and placed on ice.

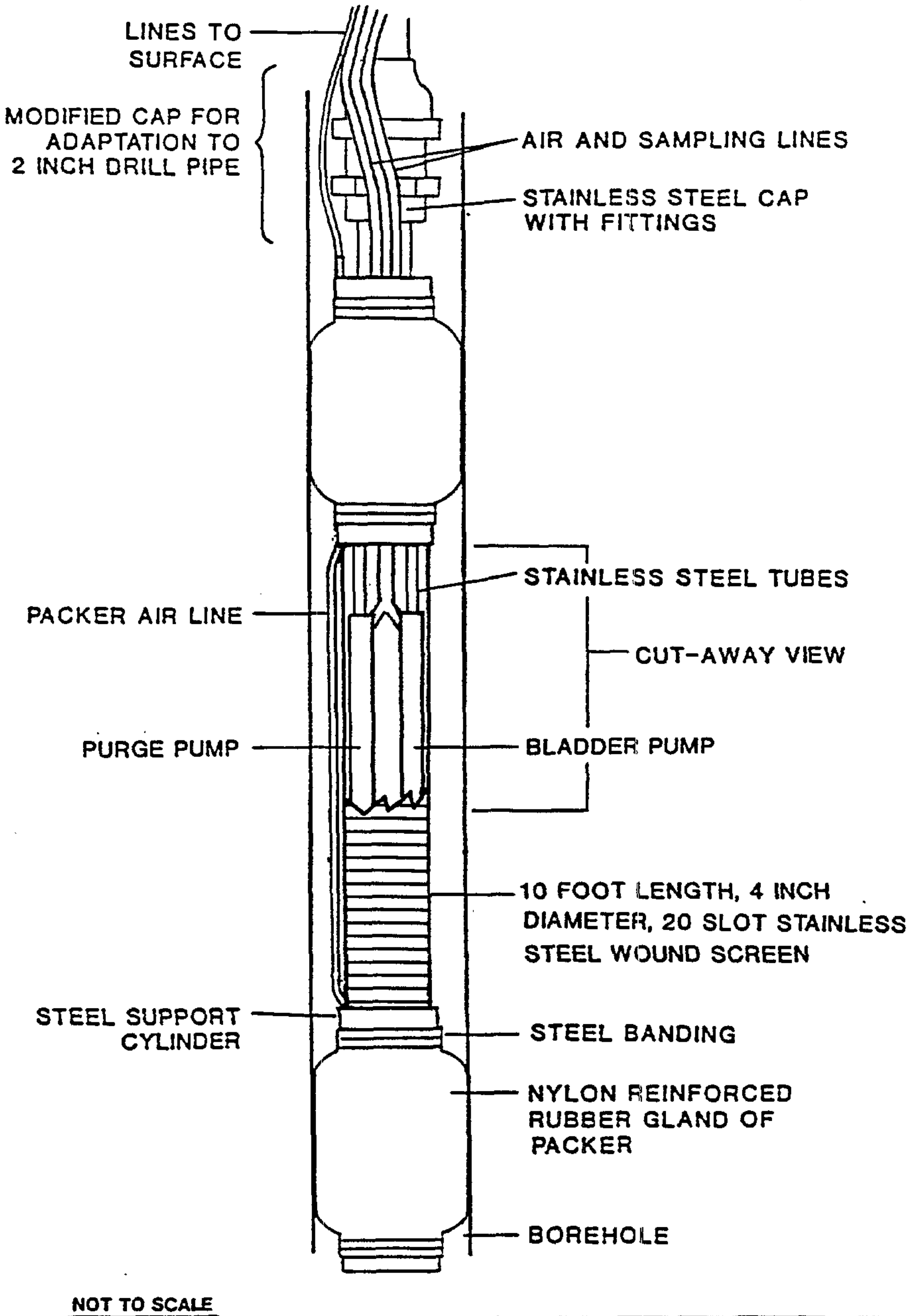


FIGURE 3-17

SCHEMATIC OF PACKER ASSEMBLY

C & D RECYCLING SITE
REMEDIAL INVESTIGATION

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The Geotech Barrel Filter was decontaminated prior to use according to the following protocols:

1) Alkanox detergent wash
2) tap water rinse
3) distilled water rinse
4) 10% nitric acid solution rinse
5) distilled water rinse

All decontamination liquids were collected, contained, and stored in the main Site building on a concrete floor. Prior to packer testing, all equipment which was to come in contact with the groundwater was steam cleaned.

The first round of packer test samples were obtained between July 29 and August 12, 1988. Table 3-25 contains a list of all packer test intervals and the water production results for intervals tested in 1988. The intervals in the existing wells were tested by lowering the packer assembly to an interval in the borehole believed to be a potential groundwater migration pathway based on analysis of geophysical logs and rock cores. A complete volume of water was removed from the interval and a sample of the groundwater taken for a screening analysis.

A HACH Spectrophotometer Model DR-3 was used on-site to screen these samples to determine the relative concentrations of lead and copper. Splits of two of the samples screened with the HACH were sent to CompuChem Laboratories for analysis of lead and copper to monitor the performance of the HACH Spectrophotometer. These two samples represent ten percent of the total number of samples screened with the HACH Spectrophotometer.

The HACH Spectrophotometer is a field screening technique which records relative copper and lead values and yields semi-quantitative results. This means that the results may not represent the <u>actual</u> copper and lead concentrations in the water but are useful for comparison to other HACH results for similar metals. Therefore, results of on-site screening are solely useful to determine the relative concentrations of lead and copper in the sampled intervals and not as a precise, quantified value.

TABLE 3-25

Packer Testing Intervals (1988)
C&D Recycling Site
Remedial Investigation

Monitoring Well	Packer Interval (ft. below grade)	Production Rate	Sampled for HACH Analysis
MW-1	30-42	Slow recharge	X
	46-58	Good production	X
	125-137	Slow recharge	X
	140-152	No recharge	
	175-187	Slow recharge	X
	195-207	Good production	X
	225-237	No recharge	
MW-2	245-257	No recharge	
	257-269	No recharge	
	269-281	No recharge	
MW-3	44-56	Slow recharge	X
	71-83	No recharge	
	90-102	Good production	X
	118-130	No recharge	
MW-4	13-25	Good production	X
	23-35	No recharge	
	50-62	No recharge	
	58-70	No recharge	
	65-77	No recharge	
MW-5	23-35	Slow recharge	X
	37-49	No recharge	
	60-72	Slow recharge	X
	82-94	Good production	X
	95-107	No recharge	
MW-6	150-162	No recharge	
	162-174	No recharge	
	200-212	Good production	X
	214-226	No recharge	
	234-246	Good production	X
	250-262	No recharge	
	335-347	No recharge	

Good production = Unable to dry interval with purge pump-- ≥ 2.5 GPM.

Slow recharge = Dried interval with purge pump. Interval recharged after approximately 30 minutes-- >0.01 GPM but <2.5 GPM.

No recharge = Dried interval with purge pump. No recharge after waiting at least 30 minutes-- ≤0.01 GPM.

TABLE 3-25

(continued)

Packer Testing Intervals (1988)
C&D Recycling Site
Remedial Investigation

Monitoring Well	Packer Interval (ft. below grade)	Production Rate	Sampled for HACH Analysis
MW-8	30-42	Slow recharge	X
	45-57	Good production	X
	100-112	No recharge	
	112-124	No recharge	
	190-202	No recharge	
	230-242	No recharge	
	250-262	No recharge	

Good production = Unable to dry interval with purge pump-- ≥2.5 GPM.

Slow recharge = Dried interval with purge pump. Interval recharged after approximately 30 minutes-- >0.01 GPM but <2.5GPM.

No recharge = Dried interval with purge pump. No recharge after waiting at least 30 minutes-- ≤0.01 GPM.

Before screening each sample for copper and lead, the sample was digested using a modified version of the "mild digestion" described by HACH in their Spectrophotometer Handbook. A 325 mL aliquot of the filtered, acidified sample was measured into a 600 mL Pyrex beaker. Approximately 1.5 mL of hydrochloric acid was added. The sample was heated in a water bath below boiling for approximately 30 minutes. After cooling for several minutes, the sample pH was adjusted to between four and six with 5M sodium hydroxide solution. The sample was then filled to the original volume with distilled water (usually about 5 mL), transferred to a 500 mL separatory funnel, and shaken.

Two 25 mL aliquots were removed through the spigot of the separatory funnel and discarded. This served to rinse both the spigot and the 25 mL sample cell used in the screening. A third 25 mL aliquot was collected in the sample cell, and the contents of a "CuVer-1" powder pillow containing bicinchoninate was added and mixed, as described in the HACH copper determination procedure. The semi-quantitative copper concentration was then read at a wavelength of 560 nm in the DR/2000 spectrophotometer. A blank consisting of sample without bicinchoninate was run with each sample.

The lead screening followed the dithizone procedure described by HACH. The lead in the remaining 250 mL in the separatory funnel was complexed with dithizone and extracted into chloroform. Cyanide was added to eliminate interferences from other metals. A 25 mL aliquot of the chloroform layer was drained into a sample cell and the semi-quantitative lead concentration read in the DR/2000 spectrophotometer. A blank of pure chloroform was run with each sample.

Standards run at the beginning of the screening work agreed within ± 11 percent for copper and ± 28 percent for lead. A method of deionized water was screened at this time and contained no lead or copper. A duplicate of one of the samples had perfect agreement for copper, while precision of the lead measurements was 29 percent. A later set of standards was run in duplicate. The copper screenings agreed within 2 percent but were 70 percent greater than their true value. This was later found to be due to the copper content of the distilled water used to make these standards. After adjusting the results of the standards for the copper in the distilled water, these standards were 98 percent accurate. The lead standards could not be used because of problems with some of the reagents (these problems were specific to these two tests and did not affect any of the samples). Semi-quantitative data showed that the distilled water also had a detectable lead content.

The effect of the metals present in the distilled water on the samples was minimal because the only distilled water to come in contact with the samples was water used to rinse the glassware that had not dried (at most, 1-2 mL) and water added after digestion to fill the samples to their original volume (about 5 mL). Therefore, the total volume of distilled water which may have been added to the samples is approximately 7 mL out of 325 mL of sample, or 2.2 percent. This minimal volume of distilled water had no significant effect on field screening results.

The second round of packer test samples were obtained between April 18 and April 28, 1989. Intervals for this round of testing were identified during the drilling of new boreholes and as retests of intervals tested in 1988. This packer testing and sampling followed the same procedure as the testing and sampling conducted in 1988. The packer assembly was lowered to the desired intervals using a drill rig. The purge pump was used to purge a complete interval volume then, if necessary, the interval was allowed to recharge.

intervals that recharged were sampled with the bladder pump. Groundwater from the sampling line was collected in a clean Geotech barrel filter and filtered through a 0.45 micron cellulose filter paper prior to preservation with nitric acid. Filtered water was collected directly into laboratory prepared sample bottles, preserved and placed on ice. Table 3-26 contains a list of all packer test intervals for the 1989 round of testing. Samples collected during this round of packer testing were sent to Adirondack Environmental Services, Inc. in Rensselaer, New York for laboratory analysis of copper and lead.

Packer testing revealed that of the thirty-eight intervals tested in 1988, eight were labeled good producing zones and of the sixteen intervals tested in 1989, twelve were labeled good producing zones. Intervals were labeled good producers if they weren't completely dewatered during purging with the purge pump. The good producing zones are given below in feet below grade:

1988:

MW-1 (46-52)	MW-4 (13-25)	MW-6 (234-246)
MW-1 (195-207)	MW-5 (82-94)	MW-8 (45-57)
MW-3 (90-102)	MW-6 (200-212)	

1989:

MW-4 (37-48)	MW-5D (114-125)	MW-8D (246-257)
MW-4 (72-83)	MW-5D (130-141)	MW-8D (257-268)
MW-5D (92-103)	MW-7 (75-86)	MW-9M (41-52)
MW-5D (103-114)	MW-8D (235-246)	MW-9M (72-83)

In the 1988 packer testing, the intervals listed above were sampled along with seven other zones designated as slow recharging intervals (Table 3-25). Slow recharging intervals generally took thirty minutes or more to recharge. In the 1989 packer testing, samples were collected from all intervals designated as good producers. The two tested intervals in MW-2 exhibited no recharge while the two tested intervals in MW-5S were labeled as slow rechargers (Table 3-26). The two MW-5S intervals were evaluated only to assess groundwater production as possible screened zones for well construction.

TABLE 3-26

Packer Testing Intervals (1989)
C&D Recycling Site
Remedial Investigation

Monitoring Well	Packer Interval (ft. below grade)	Production Rate	Sample Sent to Lab (AES)
MW-2	217-228	No recharge	
	232-243	No recharge	
MW-4	37-48	Good production	X
	72-83	Good production	X
MW-5S*	23-34	Slow recharge	
	64-75	Slow recharge	
MW-5D**	92-103	Good production	X
	103-114	Good production	X
	114-125	Good production	X
	130-141	Good production	X
MW-7	75-86	Good production	X
MW-8D	235-246	Good production	X
	246-257	Good production	X
	257-268	Good production	X
MW-9M	41-52	Good production	X
	72-83	Good production	X

* = Intervals only tested for production for screening purposes--not for lab samples.

** = Obstructions in borehole (150-180') prevented testing of deeper intervals.

Good production = Unable to dry interval with purge pump-- $\geq$2.5 GPM.

Slow recharge = Dried interval with purge pump. Interval recharged after approximately 30 minutes-- >0.01 GPM but <2.5 GPM.

No recharge = Dried interval with purge pump. No recharge after waiting at least 30 minutes-- $\leq$0.01 GPM.

The zones in monitoring well MW-8D labeled as good producers in the 1989 packer testing may be inaccurate. Core logs from corehole C-A showed no distinct fracture patterns in the intervals tested. In addition, 1988 packer test intervals corresponding to these same depths were labeled non-producers, predevelopment of the borehole prior to monitoring well construction showed poor recovery and MW-8D has not produced any water since its construction. MW-8D2, located approximately fifteen feet east of MW-8D, has a thirty foot screened zone that corresponds to the same depths as the tested intervals and has not produced any water since construction. For these reasons, the zones labeled good producers in MW-8D are probably inaccurate. Water production during the packer testing of these three intervals was probably due to an ineffective seal between the packer and borehole that allowed water above the packer assembly to seep into the interval being tested. This may also explain the inconsistency in results from MW-4 which indicated no recharge in 1988 (65 to 77 ft.) but showed good production in 1989 (72 to 83 ft.), and in MW-5 which indicated no recharge in 1988 (95 to 107 ft.) but showed good production in 1989 (92 to 114 ft.). However, unlike MW-8D in which leakage was more or less confirmed when the constructed well failed to produce water, no such evaluation was possible for the MW-4 and MW-5 intervals listed above. Another possibility in the case of these two wells is that the producing fracture identified in 1989 may have been outside the packer interval tested in 1988, since the intervals tested were not the same in either case.

The packer test samples collected in 1988 were field screened using a HACH Spectrophotometer. Results of this screening for relative lead and copper concentrations are summarized in Table 3-27. The copper screening results ranged from zero to 40 ppb and average 16.6 ppb. The lead screening results ranged from zero to 87 ppb and average 25 ppb. The highest relative lead screening result of 50 ppb and 87 ppb were found in MW-1 (46-58') and MW-1 (125-137'), respectively. All relative lead and copper screening results are generally within the same order of magnitude.

APPENDIX 6G
AGGRESSIVE WATER EVALUATION

RI Section 4.3.2.2
RI Table 4-2

Values of pH were obtained for the five residential samples collected by HART. Values of pH for the remaining twelve residences sampled by the USEPA were not available for this report. As noted previously, the Sulima well exhibits low pH values and this residence is located within 500 feet of underground mined areas based on maps provided by the Pennsylvania Department of Environmental Resources, Bureau of Anthracite Deep Mine Safety. Other sampled residences in the vicinity of this mine area are Sheaman, Evancho, Cona, Cawley, and Pennington. Analytical results for these six wells show, in many cases, elevated levels of aluminum, barium, lead, manganese, potassium, and sodium relative to the remaining residential wells and on-site wells. Information on well specifics, turbidity, pH, alkalinity, and hardness was not available to HART for these latter five residences. Therefore, no conclusions regarding the cause for the observed metals concentrations can be drawn. However, it is likely that the groundwater in this area is aggressive based on the literature (Lohman, 1937; Newport, 1977; Taylor, 1984) and the information provided in the next section.

4.3.2.2 Langelier Saturation Index. One distinct characteristic of low pH water is its aggressiveness. An aggressive water is one which tends to corrode pipes, boilers and other components of a water distribution system resulting in damage to system components and increased metals content in the water. On the other hand, a nonaggressive water will cause the deposition of a calcium carbonate film or scale which can build up in pipes, eventually resulting in the need for replacement (Hach Co., 1981).

The Langelier Saturation Index (LSI) is a measure of water's ability to dissolve or deposit calcium carbonate and is often used as an indicator of the corrosivity of water. In developing the LSI, Langelier (1936) derived an equation for determining the pH at which water is saturated with calcium carbonate (pH_s), which is based on the equilibrium expressions for calcium carbonate solubility and bicarbonate dissociation. For this study, pH_s calculations were modified to include the effects of temperature and ionic strength to approximate actual conditions more closely. The analytical procedure was developed by the Hach Co. (1981).

The LSI is defined as the difference between the actual pH measured in the field and the calculated pH_s. The pH_s is calculated using the following formula:

$$pH_s = A + B - C - D$$

Where:

A = A constant that takes into account the effect of temperature based on the field measured temperature in degrees centigrade.

B = A correction for the ionic strength of the sample based on measured total filterable residue or the estimated TDS.

C = A factor obtained by using the calcium hardness ($CaCO_3$ mg/L) of the sample.

D = A factor obtained by using the total alkalinity ($CaCO_3$ mg/L) of the sample.

The above values are obtained by using a group of tables provided by the Hach Company. These values are used to calculate pH_s. Subtracting the pH_s value from the field measured pH results in the LSI value.

The magnitude and sign of the LSI value show the water's tendency to form or dissolve scale. A LSI value greater than zero indicates the water is nonaggressive. A value between zero and -2.0 indicates moderate aggressiveness and a value less than -2.0 indicates a highly aggressive water. The calculation of pH_s is derived from the values for calcium hardness, total alkalinity, temperature and conductivity. These parameters were measured during the June 1989 sampling of the five homeowner wells and thirteen monitoring wells at the Site. A summary of the LSI values for these wells is shown in Table 4-2. Although information obtained from the LSI is not quantitative, it does serve as a general indicator of the corrosivity of water.

It can be seen from Table 4-2 that the groundwater from all but one well is either moderately or highly aggressive. This is consistent with the fact that the Mauch Chunk, Pottsville, and Llewellyn Formations all contain very little carbonate material. As a result, the groundwater exhibits low hardness and a low buffering capacity as evidenced by the fact that all but two wells exhibited actual pH values less than 7.0. Also apparent from Table 4-2 is the fact that groundwater obtained from the Sulima well has the lowest LSI value of all eighteen wells tested. This means that groundwater from the Sulima well has the greatest ability to mobilize metals from both the rock formations through which it flows and from the water distribution system within the home. This fact, in addition to the analytical results discussed above, indicates that water drawn from this well has a significantly different character than groundwater drawn from other wells, and that the properties exhibited are the same as those

TABLE 4-2

Langelier Saturation Index of Homeowner & Monitoring Wells, June 1989

C & D Recycling Site
Remedial Investigation

Well	Actual pH	pH_s[1]	L.S.I.[2]	Corrosive Characteristic
MW-1S	6.33	9.01	-2.68	Highly Aggressive
MW-1D	6.61	8.94	-2.33	Highly Aggressive
MW-3	6.55	9.18	-2.63	Highly Aggressive
MW-4S	6.14	9.24	-3.10	Highly Aggressive
MW-5S	6.68	8.41	-1.73	Moderately Aggressive
MW-5M	6.49	8.66	-2.17	Highly Aggressive
MW-5D	8.87	8.46	+0.41	Non-Aggressive
MW-6S	6.40	8.86	-2.46	Highly Aggressive
MW-6D	7.85	8.92	-1.07	Moderately Aggressive
MW-7	6.09	9.51	-3.42	Highly Aggressive
MW-8S	5.67	9.36	-3.69	Highly Aggressive
MW-9S	5.33	9.39	-4.06	Highly Aggressive
MW-9M	5.89	9.07	-3.18	Highly Aggressive
Clarke	5.60	9.73	-4.13	Highly Aggressive
Drasher	5.69	9.16	-3.47	Highly Aggressive
Rohrbach	5.05	9.54	-4.49	Highly Aggressive
Samuelian	6.05	8.91	-2.86	Highly Aggressive
Sulima	4.38	9.62	-5.24	Highly Aggressive

[1] $pH_s = A+B-C-D$ where: A = Temperature Effect
B = Ionic Strength Factor
C = Calcium Hardness Factor
D = Total Alkalinity Factor

[2] LSI = pH (actual) - pH_s

Reference: Hach Co., 1981

exhibited by acid mine water. Furthermore, groundwater samples collected from this and other residential wells were obtained from taps positioned before most in-house plumbing. Although collection close to the well limits the amount of inorganic constituents which result from the action of aggressive groundwater on in-house plumbing, aggressive groundwater may also act to corrode well casings, pumps and discharge lines and fittings. These components of the water distribution system would be in contact with groundwater before it reached the collection tap.

4.3.2.3 Water Quality Comparison With Regional Values. Regional average values for certain metals and other parameters as presented by Taylor (1984) for the Pottsville and Mauch Chunk Formations can be found in Table 2-2. With the exception of certain metals in the six residential wells discussed above, the concentrations of metals in the residential wells and on-site wells are very similar to the values for the Mauch Chunk Formation listed in Table 2-2. Exceptions to this for the on-site wells are aluminum, iron, manganese, potassium, and zinc. These five metals are the same as those discussed in Section 4.3.2 above. As explained, the high levels are due to the suspended sediment in the on-site wells. Results for filtered samples are comparable with the values in Table 2-2.

In addition to the general comparisons above, specific comparisons have been made for copper, lead, and zinc. Average values of these three metals were computed for the on-site wells, and for the residential wells sampled during this program. The results are presented in Table 4-3. Note that for on-site wells only the unfiltered results were used, and the detection limit value as reported by the laboratory was used if the results reported were non-detected. Also note that values reported as below the CRDL were used for the

APPENDIX 7
GROUND WATER QUALITY DESCRIPTION
FORM 8R

From:
Commonwealth of Pennsylvania
Department of Environmental Resources
Bureau of Waste Management

ER-WM-367: 5/92

Date Prepared/Revised

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WASTE MANAGEMENT

I.D. Number

FORM 8R
RESIDUAL WASTE LANDFILLS AND DISPOSAL IMPOUNDMENTS BASELINE GROUND WATER ANALYSIS

This form must be fully and accurately completed. All required information must be typed or legibly printed in the spaces provided herein. Replacement/substitution of or attachment to this form is prohibited. Improperly completed forms may be rejected by the Department, may be considered to be violations of the Department's Rules and Regulations, and may result in assessment of fines and penalties.

General Reference: Section 288.123, 289.123

For residual waste landfills permitted after July 4, 1992, the one year of data required shall be obtained prior to the disposal or storage of any waste at the facility. For residual waste landfills or disposal impoundments permitted before July 4, 1992, the year of data required shall be taken beginning with the first anniversary date of the issuance of the permit after July 4, 1992.

Monitoring wells must be designed and constructed in accordance with Department standards. Any additional parameters required by the Department should be added in the blank spaces provided. Detection limits should be indicated where appropriate. **INDICATE THE LATITUDE AND LONGITUDE TO THE NEAREST ONE TENTH OF A SECOND (DD° MM' SS.S").**

Facility Name: ____________________

Monitoring Point Number: __________ ___ Well ___ Spring ___ Stream ___ Other

___ Upgradient ___ Downgradient

Location: County __________ Municipality: __________

Sampling Point: Latitude: ___° ___' ___.___" Longitude: ___° ___' ___.___"

Depth to Water Level: __________ ft. Measured from: ___ Land Surface ___ TOC

Casing Stick Up: __________ ft. Elevation of Water Level: __________ ft./MSL

Sampling Depth: __________ ft. Sampling Method: ___ Pumped ___ Bailed

Well Purged: ___ Yes ___ No ___ Grab

Sample Filtered: ___ Yes ___ No Well Volumes Purged: __________

Flow Rate: __________ GPM Filter Pore Size: __________ microns

Sample Date: (mm/dd/yy) __________ Sample Collection Time: __________

Sample Collectors Name: ____________________

Sample Collectors Affiliation: ____________________

Laboratory Performing Analysis: ____________________

Lab Sample Number: __________ Lab Analysis Date: __________

Comments: ____________________

AR313019

Recycled Paper

Date Prepared/Revised

I.D. No. ____________
Monitoring Point No. ____________
Sample Date ____________

FORM 8R

PARAMETERS

SEE APPENDIX 7A (DATA BASE)

1. Inorganics (Enter all data in mg/l except as noted)

STORET NO.	PARAMETER		PROPOSED MANDATORY ABATEMENT TRIGGER LEVEL	VALUE	ANALYSIS METHOD NUMBER
(00610)	Ammonia-Nitrogen				
(00440)	Bicarbonate (as $CaCO_3$)				
(00918)	Calcium	Total			
(00915)		Dissolved			
(00340)	Chemical Oxygen Demand				
(00940)	Chloride				
(00951)	Fluoride				
(00980)	Iron (µg/l)	Total			
(01046)		Dissolved			
(01123)	Manganese (µg/l)	Total			
(01056)		Dissolved			
(00620)	Nitrate-Nitrogen				
(00403)	pH (standard units)	Field			
		Laboratory			
(00939)	Potassium	Total			
(00935)		Dissolved			
(00923)	Sodium	Total			
(00930)		Dissolved			
(00095)	Specific Conductance (µmhos/cm)	Field			
		Laboratory			
(00945)	Sulfate				
(00410)	Total Alkalinity				
(00515)	Residue, Total Filtrable at 106°C	(Total Dissolved Solids)			
(00680)	Total Organic Carbon				
(82079)	Turbidity (NTU)				

AR313020

Date Prepared/Revised

I.D. No. ____________
Monitoring Point No. ____________
Sample Date ____________

FORM 8R

SEE APPENDIX 7A (DATA BASE)

2. Metals (Enter all data in µg/l).

PARAMETER	STORET NO.		PROPOSED MANDATORY ABATEMENT TRIGGER LEVEL	VALUE	ANALYSIS METHOD NUMBER
Arsenic	(00978)	Total			
	(01000)	Dissolved			
Barium	(01009)	Total			
	(01005)	Dissolved			
Cadmium	(01113)	Total			
	(01025)	Dissolved			
Chromium	(01118)	Total			
	(01030)	Dissolved			
Copper	(01119)	Total			
	(01040)	Dissolved			
Lead	(01114)	Total			
	(01049)	Dissolved			
Magnesium	(00921)	Total			
	(00925)	Dissolved			
Mercury	(71901)	Total			
	(71890)	Dissolved			
Selenium	(00981)	Total			
	(01145)	Dissolved			
Silver	(01079)	Total			
	(01075)	Dissolved			
Zinc	(01094)	Total			
	(01090)	Dissolved			
		Total			
		Dissolved			

AR313021

Date Prepared/Revised

I.D. No. ______
Monitoring Point No. ______
Sample Date ______

FORM 8R

SEE APPENDIX 7A
(DATA BASE)

3. Organics (Enter all data in µg/l)

STORET NO.	PARAMETER	PROPOSED MANDATORY ABATEMENT TRIGGER LEVEL	VALUE	ANALYSIS METHOD NUMBER
(78124)	Benzene			
(77651)	1,2-Dibromoethane			
(34496)	1,1-Dichloroethane			
(34501)	1,1-Dichloroethene			
(34531)	1,2-Dichloroethane			
(77093)	Cis 1,2-Dichloroethene			
(34546)	Trans 1,2-Dichloroethene			
(34371)	Ethyl Benzene			
(34423)	Methylene chloride			
(34475)	Tetrachloroethene			
(78131)	Toluene			
(34506)	1,1,1,-Trichloroethane			
(39180)	Trichloroethene			
(39175)	Vinyl chloride			
(81551)	Xylene			

AR313022

APPENDIX 7A
ON-SITE MONITORING WELL
SAMPLE RESULTS

RI Tables: 3-34, 3-35b, 3-35C, 3-36, 3-37, 3-38, 3-39, 3-40, 3-41, 3-42, 3-43

Table 3-34

Summary of Groundwater Sampling and Field Parameter Information for Existing Monitoring Wells
June 28–July 8, 1988
C & D Recycling Site Remedial Investigation

Well #	Ground-Water Elevation[1]	Date Sampled	Vol. of Water Standing in Well (gal.)	Vol. of Water Removed Prior to Sampling (gal.)	Method of Evacuation	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (mmhos/cm)	pH	Sample Appearance
MW-1	1629.12	7-6-88**	339	1000	hand pump	2.95	13.0	.097	6.48	S. Cloudy
MW-2*	1588.68	7-8-88	184	150	sub. pump	0.82	14.8	.239	9.69	S. Turbid
MW-3*	1644.39	7-8-88	113.2	125	sub. pump	1.10	9.6	.080	7.14	S. Turbid
MW-4	1612.48	6-28-88	130	480	hand pump	3.69	9.9	.066	5.87	Cloudy
MW-5	1645.91	6-28-88	170	520	hand pump	3.06	9.9	.112	7.15	Cloudy
MW-6*	1599.08	7-5-88	380.4	360	sub. pump	0.95	14.8	.229	7.84	Clear
MW-8*	1649.73	7-8-88	349.5	330	sub. pump	0.94	14.1	.150	7.41	S. Turbid

1. Feet above mean sea level

* Purged by evacuation to dryness at least once

** Resampled for volatile organics sample only on 7-8-88 after pumping with submersible pump

AR313024

Table 3-35b

List of Analytical Parameters: On-Site Groundwater
C & D Recycling Site Remedial Investigation

Inorganics	Detection Limits (µg/L)
Aluminum	200
Antimony	60
Arsenic	10
Barium	200
Beryllium	5
Cadmium	5
Calcium	5000
Chromium	10
Cobalt	50
Copper	25
Iron	100
Lead	3
Magnesium	5000
Manganese	15
Mercury	0.2
Nickel	40
Potassium	5000
Selenium	5
Silver	10
Sodium	5000
Thallium	10
Vanadium	50
Zinc	20
Cyanide	10
Total Phenols	10

Pesticide Organics	Detection Limits (µg/L)
alpha-BHC	0.05
beta-BHC	0.05
delta-BHC	0.05
gamma-BHC (Lindane)	0.05
Heptachlor	0.05
Aldrin	0.05
Heptachlor epoxide	0.05
Endosulfan I	0.05
Dieldrin	0.10
4,4'-DDE	0.10
Endrin	0.10
Endosulfan II	0.10
4,4'-DDD	0.10
Endosulfan sulfate	0.10
4,4'-DDT	0.10
Methoxychlor	0.50
Endrin ketone	0.10
alpha-Chlordane	0.50
gamma-Chlordane	0.50
Toxaphene	1.00
Aroclor-1016	0.50
Aroclor-1221	0.50
Aroclor-1232	0.50
Aroclor-1242	0.50
Aroclor-1248	0.50
Aroclor-1254	1.00
Aroclor-1260	1.00

Semivolatile Organics	Detection Limits (µg/L)
Phenol	10
bis(2-Chloroethyl)Ether	10
2-Chlorophenol	10
1,3-Dichlorobenzene	10
1,4-Dichlorobenzene	10
Benzyl Alcohol	10
1,2-Dichlorobenzene	10
2-Methylphenol	10
bis(2-Chloroisopropyl)Ether	10
4-Methylphenol	10
N-Nitroso-Di-n-Propylamine	10
Hexachloroethane	10
Nitrobenzene	10
Isophorone	10
2-Nitrophenol	10
2,4-Dimethylphenol	10
Benzoic Acid	50
bis(2-Chloroethoxy)Methane	10
2,4-Dichlorophenol	10
1,2,4-Trichlorobenzene	10
Naphthalene	10
4-Chloroaniline	10
Hexachlorobutadiene	10
4-Chloro-3-Methylphenol	10
2-Methylnaphthalene	10
Hexachlorocyclopentadiene	10
Benzo(g,h,i)Perylene	10
2,4,6-Trichlorophenol	10
2,4,5-Trichlorophenol	50
2-Chloronaphthalene	10
2-Nitroaniline	50
Dimethyl Phthalate	10
Acenaphthylene	10
2,6-Dinitrotoluene	10
3-Nitroaniline	50
Acenaphthene	10
2,4-Dinitrophenol	50
4-Nitrophenol	50
Dibenzofuran	10
2,4-Dinitrotoluene	10
Diethylphthalate	10
4-Chlorophenyl-phenylether	10
Flourene	10
4-Nitroaniline	50
4,6-Dinitro-2-Methylphenol	50
N-Nitrosodiphenylamine (1)	10
4-Bromophenyl-phenylether	10
Hexachlorobenzene	10
Pentachlorophenol	50
Phenanthrene	10
Anthracene	10
Di-n-Butylphthalate	10
Fluoranthene	10
Pyrene	10
Butylbenzylphthalate	10
3,3'-Dichlorobenzidine	20
Benzo(a)Anthracene	10
Chrysene	10
bis(2-Ethylhexyl)Phthalate	10
Di-n-Octyl Phthalate	10
Benzo(b)Fluoranthene	10
Benzo(k)Fluoranthene	10
Benzo(a)Pyrene	10
Indeno(1,2,3-cd)Pyrene	10
Dibenz(a,h)Anthracene	10

Table 3-35b (continued)

List of Analytical Parameters: On-Site Groundwater
C & D Recycling Site Remedial Investigation

Volatile Organics	Detection Limits (µg/L)
Chloromethane	10
Bromomethane	10
Vinyl Chloride	10
Chloroethane	10
Methylene Chloride	5
Acetone	10
Carbon Disulfide	5
1,1-Dichloroethene	5
1,1-Dichloroethane	5
1,2-Dichloroethene (total)	5
Chloroform	5
1,2-Dichloroethane	5
2-Butanone	10
1,1,1-Trichloroethane	5
Carbon Tetrachloride	5
Vinyl Acetate	10
Bromodichloromethane	5
1,2-Dichloropropane	5
cis-1,3-Dichloropropene	5
Trichloroethene	5
Dibromochloromethane	5
1,1,2-Trichloroethane	5
Benzene	5
Trans-1,3-Dichloropropene	5
Bromoform	5
4-Methyl-2-Pentanone	10
2-Hexanone	10
Tetrachloroethene	5
1,1,2,2-Tetrachloroethane	5
Toluene	5
Chlorobenzene	5
Ethylbenzene	5
Styrene	5
Total Xylenes	5

Table 3-35c

Summary of Valid Analytical Results--On-Site Groundwater
June 28-July 8, 1988
C & D Recycling Site Remedial Investigation

Parameter	MW-1	MW-1F	MW-2	MW-2F	MW-3	MW-3F	MW-4	MW-4F	MW-5	MW-5F	MW-6	MW-6F
Metals (ppb):												
Antimony	-	-	-	-	-	-	-	-	27 **	-	-	-
Arsenic	3.2 **	1.8 **	5.7 **	-	1.9 **	2.5 **	7.1 **	-	1.6 **	-	8.2 **	-
Beryllium	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-	-
Chromium	-	-	11	-	-	-	-	-	5.4 **	-	6 **	-
Copper	19 **	15 **	38 *	25	38 *	8.4 **	-	26	-	-	-	-
Lead	4 **	-	23	-	26	-	8.9	-	4.7 **	-	22	5.8
Selenium	-	-	-	-	-	-	3 **	-	-	-	-	-
Thallium	-	-	-	-	-	-	8.3 **	-	2.7 **	-	-	-
Zinc	92	7.1 **	59	19 **	49	15 **	16 **	-	51	43	33	11 **
Barium	4.8 **	1.1 **	4.6 **	-	2.5 **	2.1 **	2.8 **	-	1.3 **	-	3.7 **	3.8 **
Iron	1700	-	515	17 **	726	-	-	-	26 **	5.1 **	897	-
Manganese	115	-	62	0.88 **	100	0.47 **	3.5 **	-	12 **	12 **	129	-
Vanadium	-	-	-	-	3.8 **	-	5.2 **	-	-	-	-	-
Aluminum	1230	-	373	67 **	471	-	-	-	21 **	-	604	-
Cobalt	-	-	-	-	4.4 **	-	-	-	-	-	-	-
Magnesium	1390 **	1160 **	-	-	863 **	832 **	955 **	-	1780 **	1730 **	366 **	-
Calcium	12500	12100	1310 **	880 **	7940	-	2610 **	-	15200 *	15100	5080	5460
Sodium	1570 **	1330 **	49300 *	53200	2050 **	-	3750 **	3870 **	3480 **	-	45200 *	44500
Potassium	-	-	-	-	-	-	3220 **	-	-	-	3040 **	-
Organics (ppb):												
Methylene Chloride	-	NA	-	NA	-	NA	2 **	NA	-	NA	-	NA
Toluene	-	NA	-	NA	6	NA	-	NA	-	NA	-	NA
2-Butanone	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Xylenes (Total)	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
bis(2-ethylhexyl)phthalate	-	NA	-	NA	-	NA	-	NA	-	NA	4 **	NA
di-n-butyl phthalate	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA
Other:												
Cyanide	-	NA	-	NA	-	NA	-	NA	-	NA	-	NA

Notes: *Estimate **Below Contract Required Detection Limit -- Compound Not Detected FB = Field Blank A = Replicate NA = Not Analyzed TB = Trip Blank F = Filtered

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

Table 3-35c (continued)

Summary of Valid Analytical Results--On-Site Groundwater
June 28-July 8, 1988
C & D Recycling Site Remedial Investigation

Parameter	MW-6A	MW-6AF	MW-8	MW-8F	TB-1	TB-2	TB-3	TB-4	TB-5	FB-10	FB-10F
Metals (ppb):											
Antimony	-	-	-	-	NA	NA	NA	NA	NA	-	-
Arsenic	8.3 **	7.4 **	10 **	5.5 **	NA	NA	NA	NA	NA	-	-
Beryllium	1.5 **	-	-	-	NA	NA	NA	NA	NA	-	1.1 **
Cadmium	-	-	-	-	NA	NA	NA	NA	NA	-	-
Chromium	6.4 **	-	24	-	NA	NA	NA	NA	NA	6.1 **	-
Copper	72 *	8.4 **	175 *	25	NA	NA	NA	NA	NA	-	-
Lead	15	-	44	5.3	NA	NA	NA	NA	NA	5	2.7 **
Selenium	-	-	11 *	-	NA	NA	NA	NA	NA	-	-
Thallium	-	-	-	-	NA	NA	NA	NA	NA	-	-
Zinc	82	8.1 *	180	32	NA	NA	NA	NA	NA	14 **	-
Barium	3.5 **	2.1 *	36 **	4.7 **	NA	NA	NA	NA	NA	-	-
Iron	665	13 *	9970	35 **	NA	NA	NA	NA	NA	-	-
Manganese	95	0.87 *	923	18	NA	NA	NA	NA	NA	-	-
Vanadium	-	-	14 **	-	NA	NA	NA	NA	NA	3.3 **	-
Aluminum	431	-	4500	27 **	NA	NA	NA	NA	NA	-	-
Cobalt	-	-	7.8 **	-	NA	NA	NA	NA	NA	-	-
Magnesium	426 **	-	2370 **	309 **	NA	NA	NA	NA	NA	155 **	-
Calcium	5550	5350	8750	6660	NA	NA	NA	NA	NA	67 **	-
Sodium	45000 *	43900	21000 *	-	NA	NA	NA	NA	NA	2120 *	-
Potassium	-	-	-	-	NA	NA	NA	NA	NA	-	-
Organics (ppb):											
Methylene Chloride	-	NA	-	NA	5	5	3 **	2 **	4 **	7	NA
Toluene	1 **	NA	14	NA	-	-	-	-	2 **	2 **	NA
2-Butanone	-	NA	3 **	NA	-	-	-	-	-	-	NA
Xylenes (Total)	-	NA	1 **	NA	-	-	-	-	-	-	NA
bis(2-ethylhexyl)phthalate	4 **	NA	-	NA	NA	NA	NA	NA	NA	-	NA
di-n-butyl phthalate	-	NA	4 **	NA	NA	NA	NA	NA	NA	-	NA
Other:											
Cyanide	-	NA	13	NA	NA	NA	NA	NA	NA	-	NA

Notes: *Estimate **Below Contract Required Detection Limit -- Compound Not Detected FB = Field Blank A = Replicate NA = Not Analyzed TB = Trip Blank F = Filtered

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

Table 3-36

Summary of Groundwater Sampling and Field Parameter Information
for Existing Monitoring Wells
October 11-12, 1988
C & D Recycling Site Remedial Investiation

Well #	Ground-Water Elevation[1]	Date Sampled	Vol. of Water Standing in Well (gal.)	Vol. of Water Removed Prior to Sampling (gal.)	Method of Evacuation	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (mmhos/cm)	pH
MW-1	1628.82	10-12-88	331.3	1000	sub. pump	3.02	14	.080	8.4
MW-3*	1627.41	10-11-88	100.6	225	sub. pump	2.24	14	.135	7.4
MW-4	1610.77	10-11-88	120.2	350	sub. pump	2.91	15	.080	9.4
MW-5	1641.61	10-12-88	159.7	350	sub. pump	2.19	15	.120	7.6
MW-6*	1572.75	10-12-88	333.7	600	sub. pump	1.80	14	.220	10.2
MW-8*	1646.23	10-11-88	367.9	485	sub. pump	1.32	15	.100	9.4

1. Feet above mean sea level

* Purged by evacuation to dryness at least once

Table 3-37

Summary of Valid Analytical Results--On-Site Groundwater
October 11-12, 1988
C & D Recycling Site Remedial Investigation

Parameter	MW-1-2	MW-1F-2	MW-3-2	MW-3F-2	MW-4-2	MW-4A-2	MW-4AF-2	MW-4F-2	MW-5-2	MW-5F-2	MW-6-2	MW-6F-2
Metals (ppb):												
Arsenic	1.2 **	-	1.7 **	-	3.4 **	3.4 **	-	-	-	-	15	15
Beryllium	1.2 **	1.1 **	2.3 **	1.2 **	1.9 **	1.1 **	1.1 **	1.1 **	1.5 **	1.1 **	1.7 **	1.5 **
Chromium	-	-	-	-	-	11	-	-	-	-	10	-
Copper	11 **	-	14 **	197	20 **	39	-	16 **	11 **	-	18 **	-
Lead	14	-	50	19	11 *	12	-	-	6.1 *	-	4.8 **	56 *
Nickel	-	-	-	-	-	-	-	-	-	-	-	-
Thallium	-	-	-	-	-	-	-	-	2.1 **	-	3.4 **	-
Zinc	10 *	20	54	199	110	94	34	43	193	18 **	76	25
Barium	1.7 **	3.2 **	5.9 **	4.7 **	22 **	39 **	5.2 **	5.6 **	8.8 **	3.2 **	6.9 **	3.2 **
Iron	108 *	66 **	1320 *	31 **	3820 *	6940 *	11 **	20 **	40300 *	149 *	743 *	11 **
Manganese	8.6 **	-	95 *	7.5 **	173 *	298 *	0.57 **	4.2 **	304 *	78 *	52 *	-
Vanadium	-	8.9 **	-	-	9 **	11 **	8.9 **	9.5 **	8.6 **	10 **	-	8.9 **
Aluminum	92 **	-	693 *	28 **	2650 *	4380 *	-	-	256 *	-	581 *	-
Cobalt	7.5 **	13 **	8.6 **	7.4 **	11 **	15 **	12 **	13 **	11 **	14 **	8.1 **	12 **
Magnesium	1610 **	1890 **	1320 **	1150 **	1990 **	3190 **	1670 **	1710 **	2310 **	2240 **	621 **	723 **
Calcium	10800	10300	7620	8190	6440	10400	9730	9830	16500	15300	6980	5130
Sodium	4170 **	7850	3290 **	3780 **	4870 **	5460	6910	7380	6360	8620	68000	57000
Potassium	-	4140 **	-	-	-	-	2970 **	4000 **	-	3800 **	-	2880 **
Organics (ppb):												
Methylene Chloride	-	NA	-	NA	-	-	NA	NA	-	NA	-	NA
bis(2-ethylhexyl)phthalate	-	NA	-	NA	-	-	NA	NA	3 **	NA	-	NA
Other:												
Cyanide (ppb)	-	NA	-	NA	-	-	NA	NA	-	NA	-	NA

Notes: *Estimate **Below Contract Required Detection Limit — Compound Not Detected FB = Field Blank A = Replicate NA = Not Analyzed TB = Trip Blank F = Filtered

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

Table 3-37 (continued)

Summary of Valid Analytical Results--On-Site Groundwater
October 11-12, 1988
C & D Recycling Site Remedial Investigation

Parameter	MW-8-2	MW-8F-2	TB-6	TB-7	TB-8
Metals (ppb):					
Arsenic	3 **	2.5 **	NA	NA	NA
Beryllium	2.3 **	1.9 **	NA	NA	NA
Chromium	-	-	NA	NA	NA
Copper	18 **	9.2 **	NA	NA	NA
Lead	9.8	2.3 **	NA	NA	NA
Nickel	-	-	NA	NA	NA
Thallium	-	-	NA	NA	NA
Zinc	178	180	NA	NA	NA
Barium	7.9 **	5.6 **	NA	NA	NA
Iron	510 *	24 **	NA	NA	NA
Manganese	61 *	17 *	NA	NA	NA
Vanadium	-	4.5 **	NA	NA	NA
Aluminum	244 *	-	NA	NA	NA
Cobalt	7.3 **	8.8 **	NA	NA	NA
Magnesium	1530 **	1510 **	NA	NA	NA
Calcium	11100	11000	NA	NA	NA
Sodium	7480	7490	NA	NA	NA
Potassium	-	-	NA	NA	NA
Organics (ppb):					
Methylene Chloride	-	NA	-	98	-
bis(2-ethylhexyl)phthalate	5 **	NA	NA	NA	NA
Other:					
Cyanide (ppb)	-	NA	NA	NA	NA

Notes: *Estimate **Below Contract Required Detection Limit — Compound Not Detected FB = Field Blank A = Replicate NA = Not Analyzed TB = Trip Blank F = Filtered

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

Table 3-38

Summary of Groundwater Sampling and Field Parameter Information for Existing Monitoring Wells January 19-20, 1989 C & D Recycling Site Remedial Investigation

Well #	Ground-Water Elevation[1]	Date Sampled	Vol. of Water Standing in Well (gal.)	Vol. of Water Removed Prior to Sampling (gal.)	Method of Evacuation	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (mmhos/cm)	pH	Sample Appearance
MW-1	1628.67	1-20	331	1000	sub. pump	3.02	9.1	.730	6.39	clear
MW-3*	1647.83	1-19	110	360	sub. pump	3.27	9.3	.056	6.67	clear
MW-4	1615.22	1-19	127	450	sub. pump	3.54	8.8	.074	6.40	slightly cloudy
MW-5*	1646.73	1-20	167	530	sub. pump	3.17	9.0	.118	7.05	slightly cloudy
MW-6*	1611.75	1-20	266	742.5	sub. pump	2.79	9.0	.240	9.11	slightly cloudy
MW-8*	1651.45	1-20	257	645	sub. pump	2.51	7.3	.088	5.67	clear

1. Feet above mean sea level

* Purged by evacuation to dryness at least once

Table 3-39

Summary of Valid Analytical Results--On-Site Groundwater
January 19-20, 1989
C & D Recycling Site Remedial Investigation

Unfiltered	MW-1	MW-3	MW-4	MW-4A	MW-5	MW-6	MW-8	Field Blank
Copper	10.4**	-	12.5**	10.4**	16.7**	25.0	8.4**	259
Lead	1.3**	2.3**	-	-	1.5**	3.3**	0.93**	-
Manganese	5.4**	5.4**	42.9	16.3	172	52.5	30.8	-

Filtered	MW-1	MW-3	MW-4	MW-4A	MW-5	MW-6	MW-8	Field Blank
Copper	12.5**	-	-	-	-	-	12.5**	259
Lead	-	-	-	-	-	-	-	-
Manganese	-	-	5.6**	7.0**	103	-	5.4**	-

**Below Contract Required Detection Limits
- Not detected.
The above three metals were the only analyses performed on these samples.
All results shown are in part per billion (ppb).

Table 3-40

Summary of Groundwater Sampling and Field Parameter Information
for Existing Monitoring Wells
April 3-5, 1989
C & D Recycling Site Remedial Investigation

Well #	Ground-Water Elevation[1]	Date Sampled	Vol. of Water Standing in Well (gal.)	Vol. of Water Removed Prior to Sampling (gal.)	Method of Evacuation	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (umhos/cm)	pH
MW-1	1631.44	4-5	320	1000	sub. pump	3.13	9.0	.079	6.33
MW-3*	1656.91	4-3	93	280	sub. pump	3.01	9.5	.078	6.41
MW-4	1619.66	4-4	112	350	sub. pump	3.13	7.1	.720	6.04
MW-5*	1652.83	4-5	142	300	sub. pump	2.11	7.4	.113	6.24
MW-6*	1622.04	4-5	370	450	sub. pump	1.22	10.4	.237	9.06
MW-8*	1663.73	4-4	366	340	sub. pump	0.93	10.7	.083	5.24

1. Feet above mean sea level

* Purged by evacuation to dryness at least once

Table 3-41

Summary of Valid Analytical Results Groundwater
April 3-5, 1989
C & D Recycling Site Remedial Investigation

Parameter	MW-01-03	MW-01A-03	MW-01A-03F	MW-01-03F	MW-03-03	MW-03-03F	MW-04-03	MW-04-03F	MW-05-03	MW-05-03F	MW-06-03	MW-06-03F	MW-08-03	MW-08-03F	FB-01-03	TB-040489	TB-040589	TB-040389
Metals (ppb):																		
Arsenic	---	---	---	---	---	---	---	---	---	---	29	---	---	---	---	NA	NA	NA
Beryllium	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	NA	NA	NA
Chromium	---	---	---	---	---	---	---	---	---	---	8.0**	---	---	---	---	NA	NA	NA
Copper	12.9**	10.4**	---	---	5.3**	---	6.9**	---	---	---	11.7**	---	---	---	---	NA	NA	NA
Lead	R	31.5	0.92**	0.47**	7.8	0.41**	4.2**	---	2.0**	0.81**	3.0**	---	---	---	0.57**	NA	NA	NA
Nickel	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	NA	NA	NA
Thallium	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	NA	NA	NA
Zinc	95.4*	97.8*	26.5	13.1**	74.8*	45.0*	128*	32.7	86.4*	17.2**	55.0*	7.6*	15.0**	R	6.3**	NA	NA	NA
Barium	5.8**	3.2**	---	---	4.0**	3.4**	16.9**	17.2**	6.1**	4.5**	7.6**	---	19.6**	8.1**	---	NA	NA	NA
Iron	908	714	8.6**	8.6**	610	11.6**	19300	14.2**	34600	436	1310	17.0**	704	214	---	NA	NA	NA
Manganese	38.2	36.7	4.3**	2.4**	50.1	4.8**	152	6.4**	272	109	95	2.9**	49.2	18.8	2.0**	NA	NA	NA
Vanadium	11.3**	18.4**	6.4**	---	---	---	---	---	---	---	18.5**	13.1*	6.8**	---	---	NA	NA	NA
Aluminum	393	321	---	---	469	---	1280	---	310	---	835	---	625	---	---	NA	NA	NA
Cobalt	---	7.2**	---	---	5.4**	---	---	---	---	---	---	---	5.8**	---	7.0**	NA	NA	NA
Magnesium	1600**	1880**	1870**	1730**	1190**	---	2040**	---	2240**	2240**	483**	408**	2630**	1730**	---	NA	NA	NA
Calcium	9070	9350	9280	8990	9380	9690	7940	6610	15300	16900	4590**	4200**	6680	R	---	NA	NA	NA
Sodium	---	5760	6090	R	3800**	R	---	---	5210	R	48600	51300	5310	3260**	---	NA	NA	NA
Potassium	---	---	R	---	---	---	---	---	---	---	---	R	---	---	---	NA	NA	NA
Mercury	---	---	---	---	0.27	---	---	---	---	---	---	---	---	---	---	NA	NA	NA
Organics (ppb):																		
Carbon Disulfide	2**	---	NA	NA	---	NA	3**	NA	---	NA	---	NA	3**	NA	---	---	---	---
bis(2-Ethylhexyl)phthalate	---	---	NA	NA	---	NA	4**	NA	9**	NA	3**	NA	2**	NA	---	NA	NA	NA
Acetone	---	---	NA	NA	---	NA	---	NA	---	NA	---	NA	---	NA	---	9**	---	---
Methylene Chloride	---	---	NA	NA	---	NA	---	NA	---	NA	---	NA	---	NA	3**	7	3**	3**
Other:																		
Cyanide (ppb)	---	---	NA	NA	---	NA	---	NA	---	NA	---	NA	---	NA	---	NA	NA	NA

Notes: * Estimate Only ** Value Below Contract Required Detection Limit --- Compound Not Detected FB = Field Blank A = Replicate NA = Not Analyzed TB = Trip Blank F = Filtered R = Result Unusable

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

AR313035

Table 3-42

Summary of Groundwater Sampling and Field Parameter Information
for Completed Monitoring Wells
June 20-22, 1989
C & D Recycling Site Remedial Investigation

Well #	Ground-Water Elevation[1]	Date Sampled	Vol. of Water Standing in Well (gal.)	Vol. of Water Removed Prior to Sampling (gal.)	Number of Well Volumes Evacuated	Temp. (°C)	Specific Conductivity (mmhos/cm)	pH	Turbidity (NTU)	Sample Appearance
MW-1S	1651.27	6-21	9.0	66.0**	7.33	11.5	.103	6.33	115.3	cloudy
MW-1D	1561.52	6-21	19.0	60.0	3.16	11.3	.125	6.61	42.0	clear
MW-3	1662.81	6-22	11.2	53.0	4.73	11.9	.083	6.55	35.2	clear
MW-4S	1620.26	6-22	2.7	10.0	3.70	11.6	.075	6.14	60.2	clear
MW-5S	1655.05	6-21	11.5	38.0	3.30	11.1	.167	6.68	20.2	very clear
MW-5M	1655.08	6-21	14.7	68.0	4.63	11.3	.113	6.49	94.2	slightly cloudy
MW-5D*	1528.77	6-21	13.5	9.0***	0.67	11.4	.272	6.87	>200	silty
MW-6S	1654.50	6-20	4.5	20.0	4.44	15.6	.119	6.40	95.0	slightly cloudy
MW-6D	1559.23	6-20	18.7	60.0	3.21	12.5	.170	7.85	108.0	slightly cloudy
MW-7	1668.58	6-20	3.6	88.0*	24.4	13.1	.072	6.09	66.3	clear
MW-8S	1660.05	6-20	4.0	15.0	3.75	12.5	.086	5.67	>200	silty
MW-9S	1650.12	6-21	4.3	15.0	3.49	11.7	.089	5.33	20.4	very clear
MW-9M	1652.23	6-21	9.5	36.0	3.79	12.0	.105	5.89	69.9	clear

1. Feet above mean sea level

* Purged by evacuation to dryness at least once

** Water silty during purging. Let pump to allow to clear up prior to sampling.

***Well dried out prior to desired volume removal. Pumped shortly prior to sampling to clear water out of the hose.

Note: All wells were developed and sampled using the Waterra inertial pump system.

Table 3-43

Summary of Valid Analytical Results--On-Site Groundwater
June 20-22, 1989
C & D Recycling Site Remedial Investigation

Filtered Parameter	MW-1S-04	MW-1D-04	MW-3-04	MW-4S-04	MW-5S-04	MW-5M-04	MW-5D-04	MW-6S-04	MW-6D-04	MW-7-04	MW-8S-04	MW-9S-04	MW-9S-04D	MW-9M-04	FB-062189	TB-062189	TB-062289
Metals (ppb):																	
Aluminum	2630	1130	821	871	168**	1910	14200	1170	5250	1340	3060	225	219	1220	---	NA	NA
Arsenic	2.7**	1.3**	1.5**	---	---	2.8**	59.4	1.6**	7.5**	2.8**	2.8**	---	---	2.2**	---	NA	NA
Barium	33.9**	22.9**	10.8**	14.8**	7.5**	7.0**	210	18.0**	28.0**	7.9**	38.1**	11.2**	11.2**	18.4**	---	NA	NA
Beryllium	3.1**	---	---	---	---	---	3.7**	---	---	---	---	---	---	---	---	NA	NA
Calcium	14500	11700	10000	8720	22800	19300	14700	13200	5450	6920	10200	8660	8660	13900	---	NA	NA
Chromium	---	---	16.3	---	---	---	25.8	---	4.7**	---	5.6**	---	---	---	---	NA	NA
Cobalt	7.6**	6.0**	7.0**	7.8**	4.9**	5.4**	14.7**	5.0**	5.0**	5.8**	8.5**	6.1**	5.0**	7.2**	3.5**	NA	NA
Copper	12.4**	12.4**	12.4**	12.4**	---	---	42.2*	---	47.1	---	14.1**	---	---	---	---	NA	NA
Iron	2920	1740	783	1760	424	1160	40500	1590	3870	1870	5350	366	334	1940	6.7**	NA	NA
Lead	6.5	3.3**	2.2**	2.5**	---	3.0**	36.2	2.8**	7.7	3.0**	8.3	---	---	1.9**	---	NA	NA
Magnesium	2380**	1940**	2620	1690**	1900**	2730**	4110**	1970**	1720**	1540**	2570**	2320**	2370**	2170**	105**	NA	NA
Manganese	305	239	646	87.9	33.7	38.1	1730	267	234	143	377	37.5	37.5	243	---	NA	NA
Mercury	---	---	---	---	---	---	---	---	---	---	---	---	0.46	0.18	---	NA	NA
Nickel	---	---	---	---	18.8*	---	---	21.1**	34.4**	23.0**	20.4**	---	30.3**	---	31.9**	NA	NA
Potassium	---	---	---	---	2430**	2700**	2190**	3140**	2370**	2280**	3600**	3420**	3600**	2860**	2270**	NA	NA
Selenium	---	---	---	---	---	---	---	---	19.6**	---	---	---	---	---	---	NA	NA
Sodium	5940*	9810*	3770**	2840**	4170**	4450**	59800	7700	38800	3110**	4750**	4130**	4340**	3910**	---	NA	NA
Vanadium	4.8**	---	---	6.7**	4.0**	4.7**	30.4**	5.9**	8.1**	6.7**	11.8**	5.1**	6.2**	5.4**	1.9**	NA	NA
Zinc	160	61.1	36.9	59.8	13.8**	23.2*	192	55.7*	69.4*	32.5*	29.8*	46.2*	31.4*	66.3*	10.9**	NA	NA
Organics (ppb):																	
Acetone	21*	---	---	---	---	---	170*	130*	200*	---	---	---	---	---	---	---	---
Methylene Chloride	---	---	---	---	---	---	---	---	---	---	---	---	---	---	4**	---	2**
Carbon Disulfide	---	---	---	---	---	---	---	---	---	---	---	---	---	---	10	---	---
Ethylbenzene	---	---	---	---	---	---	---	---	---	---	---	---	---	---	1**	---	---
bis(2-Ethylhexyl)phthalate	---	---	---	---	---	---	---	---	---	---	---	---	---	---	6**	---	---
Other:																	
Cyanide (ppb)	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	NA	NA
Alkalinity (mg/L)	26	36	20	18	58	43	110	26	54	13	14	8.6	12	19	3.6	NA	NA
Hardness (mg/L)	40	34	34	34	72	54	34	44	22	26	32	42	30	46	2.0	NA	NA

Notes: * Estimate Only ** Value Below Contract Required Detection Limit --- Compound Not Detected NA = Not Analyzed F = Filtered FB = Field Blank TB = Trip Blank R = Result Unusable

D = Duplicate. Refers to D at the end of a sample ID.

Analytical parameters listed in Table 3-35b that are not shown above were not detected in any sample.

AR313037

Table 3 (continued)

Summary of Valid Analytical Results--On-Site Groundwater
June 20-22, 1989
C & D Recycling Site Remedial Investigation

Unfiltered Parameter	MW-1S-04F	MW-1D-04F	MW-3-04F	MW-4S-04F	MW-5S-04F	MW-5I-04F	MW-5D-04F	MW-6S-04F	MW-6D-04F	MW-7-04F	MW-8S-04F	MW-9S-04F	MW-9S-04FD	MW-9I-04F	FB-062189F
Metals (ppb):															
Aluminum	40.2**	56.0**	---	---	---	49.8**	123**	21.7**	235	46.6**	129**	---	---	---	---
Arsenic	1.3**	---	---	---	---	1.4**	58.0**	1.7**	7.3**	---	---	---	X	1.7**	---
Barium	6.0**	13.8**	---	6.0**	5.0**	3.4**	10.3**	13.0**	5.8**	4.3**	5.8**	12.0**	11.3**	5.0**	X
Calcium	11,100	10400	9860	8560	22700	16500	4870**	11400	1800**	9370	8480	8450	8720	12900	X
Chromium	X	---	---	---	---	---	X	---	---	---	---	---	---	---	---
Cobalt	---	---	---	---	---	3.8**	X	3.4**	---	---	---	---	---	---	---
Copper	---	---	---	---	---	---	43.5	---	---	---	---	---	---	---	---
Iron	66.6**	26.2**	---	---	---	11.0**	12000	12.9**	136	56.7**	308	---	---	---	---
Lead	---	---	---	---	X	1.1**	1.0**	2.3**	4.9**	1.1**	2.4**	---	X	1.2**	X
Magnesium	1430**	1430**	892**	1360**	1660**	2210**	2180**	1530**	---	1610**	1640**	1870**	2160**	1700**	---
Manganese	114*	216*	12.6**	---	13.4**	---	170*	227*	25.2*	25.2*	53.1*	10.1**	7.3**	11.2**	---
Mercury	---	---	---	---	---	---	---	---	---	---	---	X	---	0.20*	---
Nickel	---	---	---	---	---	---	X	---	---	---	---	---	---	---	---
Potassium	---	---	---	---	---	X	---	---	---	X	---	---	---	---	---
Selenium	---	---	---	---	---	---	---	---	13.1*	---	---	---	---	---	---
Sodium	3130**	X	---	---	3280**	X	57400	6440	37700	X	2720**	1860**	---	2670**	---
Vanadium	---	X	---	---	---	X	23.8**	2.9**	---	4.7**	---	---	---	---	---
Zinc	41.8	38.1	X	14.3**	12.6**	19.2**	X	47.3*	X	20.0**	19.6**	16.8**	8.9**	20.5*	X

Notes: * Estimate Only ** Value Below Contract Required Detection Limit --- Compound Not Detected NA = Not Analyzed F = Filtered FB = Field Blank TB = Trip Blank X = Result Unusable

D = Duplicate. Refers to D at the end of a sample ID.

The following metals were below detection in all samples: Sb, Cd, Cr, Ag, Tl.

APPENDIX 7B
OFF-SITE RESIDENTIAL WELL SAMPLE RESULTS

RI Tables: 3-46, 3-45, 3-47, 3-50 and 3-52

Table 3-46

Summary of Valid Analytical Results
Residential Well Sampling
June 29-30, 1988
C & D Recycling Site Remedial Investigation

	Site					
Parameter	Drasher	Clarke	Clarke-1A	Sulima	Rohrbach	Samuelian
Metals:						
Aluminum	--	--	--	14,500	--	--
Arsenic	--	--	--	5.3**	--	--
Barium	2.7**	1.4**	--	60**	13**	1.8**
Calcium	11,700*	1,340**	1,340**	3,630**	10,500*	7,630*
Chromium	5.4**	--	--	11	--	--
Cobalt	--	--	--	14**	--	4.3**
Copper	28*	68*	105*	120*	33*	33*
Iron	--	57**	101	16,100	18**	111
Lead	4.8**	5.4**	4.8**	41	5.6	2.4**
Magnesium	2,010**	202**	449**	1010**	2,660**	2,110**
Manganese	--	--	--	490	1.4**	1.0**
Mercury	--	--	--	.34*	--	--
Potassium	--	--	--	--	--	2,660**
Silver	--	--	--	--	--	8.8**
Sodium	4,150**	--	--	5,570*	3,300**	5,750
Thallium	2.0**	--	--	--	--	--
Vanadium	--	--	--	6.7**	--	5.8**
Zinc	29	27	22	297	10**	1.3**
Cyanide	--	364	16	21	--	12
Organics:						
Methylene Chloride	1**	6	--	3*	--	--

Notes: * - Estimate Only
** - Value below Contract Required Detection Limit
-- - compound not detected

All values are ppb.

Analytical parameters listed in Table 3-44 that are not shown above were not detected in any sample.

AR313040

Table 3-45

Resident Well Sampling and Field Parameter Information
June 29-30, 1988
C & D Recycling Site Remedial Investiation

Residence	Tap Location	pH	Temperature (°C)	Specific Conductance Corrected to 25°C (mmhos/cm)
Drasher	Basement before holding tank	6.14	11.4	.102
Samuelian	Basement before holding tank	6.30	12.0	.111
Clarke	Back of garage before holding tank	5.78	11.1	.017
Rohrbach	Basement before holding tank	6.85	11.5	.091
Sulima	Basement before holding tank	4.74	11.7	.103

Table 3-47

Residence Well Sampling and Field Parameter Information
April 3-4, 1989
C & D Recycling Site Remedial Investiation

Residence	Tap Location	pH	Temperature (°C)	Specific Conductance Corrected to 25°C (mmhos/cm)
Drasher	Basement before holding tank	5.85	11.0	.099
Samuelian	Backyard spigot	6.08	10.9	.112
Clarke	Outside spigot under porch	5.60	10.5	.019
Rohrbach	Basement before holding tank	5.12	12.6	.062
Sulima	Basement before holding tank	4.2	10.1	.111

Table 3-50

Residential Well Sampling and Field Parameter Information
June 19-20, 1989
C & D Recycling Site Remedial Investigation

Residence	Tap Location	pH	Temperature (°C)	Specific Conductance Corrected to 25°C (mmhos/cm)
Drasher	Basement before holding tank	5.69	11.2	.99
Samuelian	Backyard spigot	6.05	10.8	.111
Clarke	Outside spigot under porch	5.60	10.9	.019
Rohrbach	Basement before holding tank	5.05	11.1	.64
Sulima	Basement before holding tank	4.38	11.0	.108

Table 3-52

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

Analyte	Jean Cawley					Chester Cenzar					Martin Clarke			
	10/88	1/89	4/89	6/89	Dup.	10/88	1/89	4/89	6/89	Dup.	10/88	1/89	4/89*	6/89*
Aluminum	-	-	63.7	48.8	-	159	-	-	-	-	-	-	-	-
Antimony	-	-	-	11.4	-	37	-	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	53	-	46.9	6.4	6.4	-	-	2.6	3.2	-	-	-	2.4	3.2
Beryllium	-	-	1.7	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	5110	3930	4650	5540	5320	12600	11800	11200	10100	10600	2580	1540	1510	1410
Chromium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	5.1	-	-	-	-	-	-	-	-	8	-
Copper	118	29.7	59.4	81.2	81.3	79	22.4	32.3	24.7	16.9	87	57.1	53.3	58.3
Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	190	23.9	17.2	20.2	504	17000	115	46	67.6	52.6	1470	-	-	-
Lead	2.9	2.2	14.2	8.9	9.1	12	1.9	1.2	3.6	3.4	-	2.4	1.1	1.5
Magnesium	1550	1120	1340	1440	1380	1840	1390	1180	1090	1110	1120	744	1030	645
Manganese	-	12.6	3	-	-	86	14.0	-	-	-	-	4.6	3.2	4.8
Mercury	0.6	-	-	-	-	0.5	-	-	-	-	0.5	-	-	-
Nickel	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	-	326	309	442	266	-	-	266	188	277	-	276	-	-
Selenium	-	-	6.2	1.2	2	-	-	2	-	-	-	-	-	-
Silver	-	15.9	-	2.7	-	-	21.4	-	5.3	2.4	-	-	-	-
Sodium	3400	1690	1540	1550	1480	2640	1390	1320	1230	1250	1700	717	4130	-
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-	-	-	-	-	5.9	-
Zinc	50	19.0	15.2	11.5	22.1	1540	30.1	39.7	18	16.4	180	9.4	20.2	6.4

*Results from HART sampling.
- Not detected.

AR313044

Table 3-52 (continued)

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

	Cona				Drasher					Joseph Ivancho				
Analyte	10/88	1/89	4/89	6/89	10/88	1/89	4/89*	6/89*	Dup.*	10/88	1/89	4/89	Dup.	6/89
Aluminum	607	-	38.3	51.1	-	-	-	-	-	-	68.4	81.1	98.2	134
Antimony	-	-	-	-	-	-	-	-	-	-	-	-	-	12.5
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	18.6	16.5	-	-	3.4	2.9	5.1	-	22.3	21.6	21.6	22.3
Beryllium	-	-	1.7	-	-	-	-	-	3	-	-	1.7	1.7	-
Cadmium	8.4	-	-	-	-	-	-	-	-	17	-	-	-	-
Calcium	4570	4920	3750	3620	12500	10100	10800	11000	11000	4200	3730	3420	3400	3590
Chromium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	6.4	-	3.8	-	-	-	-	5.9
Copper	42	18.2	10.5	106	63	61.2	3.8	38.9	31.6	59	26	12.6	13.2	13.9
Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	146	466	92.7	25.3	-	22.9	11.5	-	-	170	66.3	14.9	14.4	53
Lead	18	27.2	30.3	3	1.8	32.2	-	8	2.7	-	10.6	16	11.2	9.1
Magnesium	1480	1790	1760	1590	2150	1590	1820	1730	1870	1540	1480	1420	1450	1450
Manganese	-	27.9	25.8	19.6	8.3	5.7	2.2	4	8.3	76	84.1	81.9	82.1	79.8
Mercury	0.5	-	-	-	0.4	-	-	-	-	0.2	-	-	-	-
Nickel	-	-	-	-	-	-	-	-	-	-	-	-	-	8.5
Potassium	-	445	606	523	2100	335	-	-	-	-	521	507	569	532
Selenium	-	-	1.6	-	-	-	-	-	-	-	-	-	-	1.6
Silver	-	-	-	4.8	-	21.4	-	-	-	9.4	-	-	-	2.2
Sodium	6610	8320	9590	8310	4260	2716	4470	1900	2870	13000	13000	13000	13200	12200
Thallium	-	-	-	-	-	-	-	-	1.4	-	-	-	-	-
Tin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-	4.6	-	-	-	-	
Zinc	-	79.7	14.2	14.7	-	17.7	14	44.7	18.4	25	18.3	22.5	19	20.7

*Results from HART sampling.
- Not detected.

AR313045

Table 3-52 (continued)

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

Analyte	Kapracevsky 1/89	Kapracevsky 4/89	Kapracevsky 6/89	Maple Lane Trailer Park 10/88	Maple Lane Trailer Park 1/89	Maple Lane Trailer Park 6/89	Joseph Martincek 10/88	Joseph Martincek 1/89	Joseph Martincek 4/89	Joseph Martincek 6/89	George Pennington 10/88	George Pennington 1/89	George Pennington 4/89	George Pennington 6/89
Aluminum	-	30.4	-	184	-	-	-	-	58.2	69.8	352	-	55.1	26.8
Antimony	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	1.7	2.3	-	-	3.7	-	-	20.3	19.8	-	-	5.9	5.8
Beryllium	-	-	-	-	-	-	-	-	1.7	-	-	-	1.7	-
Cadmium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Calcium	9800	8250	6210	6060	2000	1340	4310	3130	3450	3680	8860	7780	6880	7580
Chromium	-	7.2	-	-	-	-	-	-	-	-	-	-	-	-
Cobalt	-	-	4.4	-	-	-	-	-	-	-	-	-	-	-
Copper	13.0	9.7	13.2	52	13.6	6.9	184	40.8	38.4	23.9	156	31.6	21.6	38.9
Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	-	34.4	-	-	33.3	53.2	308	248	23.3	35.5	169	102	61.6	82.6
Lead	-	-	2.2	1.5	2.3	3.8	6.5	4.6	-	9.8	26	11.2	5.7	18
Magnesium	1180	1100	944	1880	1318	733	1490	1240	1600	1530	2660	2200	2250	2230
Manganese	5.5	-	-	-	4.4	29.1	146	89.7	83.1	95.3	-	23.3	13.1	3.8
Mercury	-	-	-	0.5	-	-	0.5	-	-	-	0.5	-	-	-
Nickel	-	-	-	9.8	-	-	-	-	-	-	-	-	-	-
Potassium	332	343	338	-	276	311	-	523	717	658	-	486	507	467
Selenium	-	2.1	-	-	-	-	-	-	-	-	-	-	-	-
Silver	-	-	3.7	-	-	-	-	24.9	-	-	-	11.2	-	-
Sodium	1870	1860	1620	1580	570	964	2920	2250	2700	2460	4600	3310	3010	3010
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tin	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	6.7	-	11.8	-	9.6	14.3	22	30.5	12.9	16.6	-	43.3	15.2	20

*Results from HART sampling.
- Not detected.

Table 3-52 (continued)

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

Analyte	Dean Oberst					Ronald Rapczynski			Thomas Rock			
	10/88	1/89	4/89	Dup.	6/89	10/88	4/89	6/89	10/88	1/89	4/89	6/89
Aluminum	-	-	-	57.4	-	160	-	50.7	-	-	-	-
Antimony	-	-	-	-	-	-	-	19.6	-	-	-	-
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-
Barium	-	-	6.6	10.5	5.5	-	3.0	5.8	-	-	1.7	3.7
Beryllium	-	-	-	-	-	-	-	-	-	-	-	-
Cadmium	-	-	-	2.7	-	-	-	-	-	-	-	-
Calcium	9120	10400	4530	4470	3920	9330	7390	13100	2480	1560	1620	1570
Chromium	-	8.3	-	4.3	-	-	-	-	-	-	-	-
Cobalt	-	-	-	-	-	-	-	4.4	-	-	-	-
Copper	81	26.2	18.8	24.2	13.5	89	6.3	507	60	18.1	16.7	71.2
Cyanide	-	-	-	-	-	-	-	-	-	-	-	-
Iron	210	35.9	36	73	-	323	24.6	549	237	161	37.5	18.1
Lead	3.7	5.6	9.9	9.5	4.9	31	1.7	2.8	9.3	10.3	-	6.2
Magnesium	1900	1890	1370	1430	1300	1560	1180	1570	915	686	726	684
Manganese	-	16.0	10.5	13.2	9.4	15	1.3	11.7	-	7.2	-	-
Mercury	0.4	-	-	-	-	0.5	-	-	0.8	-	-	-
Nickel	-	-	-	-	-	-	-	17.9	-	-	-	-
Potassium	-	332	520	558	522	-	371	525	-	268	254	228
Selenium	-	-	-	-	-	-	-	2.3	-	-	-	-
Silver	5.1	-	-	-	-	-	-	-	-	-	-	-
Sodium	1640	896	1430	1460	1150	3830	2820	4230	1270	485	478	531
Thallium	-	-	-	-	-	-	-	-	-	-	-	-
Tin	-	-	-	-	-	-	-	-	-	-	-	-
Vanadium	-	-	-	3.2	-	-	-	-	-	-	-	-
Zinc	-	10.1	-	3.8	-	29	-	356	-	8.7	-	9.2

*Results from HART sampling.
- Not detected.

Table 3-52 (continued)

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

	Sharon Rohrbach				Christine Samuelian					Merritt Sheaman			
Analyte	10/88	1/89	4/89a	6/89a	10/88	1/89	4/89a	Dup.a	6/89	10/88	1/89	4/89	6/89
Aluminum	-	-	52.5	241	-	-	-	-	-	886	-	-	126
Antimony	-	-	-	-	-	-	-	-	-	-	-	-	
Arsenic	-	-	-	-	-	-	-	-	-	-	-	-	
Barium	-	-	28.4	25.4	-	-	-	-	2.9	-	21.7	14.4	8.4
Beryllium	-	-	-	-	-	-	-	-	-	-	-	-	
Cadmium	-	-	-	-	-	-	-	-	-	9.1	-	-	-
Calcium	12400	8260	3560	2920	12600	12600	12700	12400	12000	8210	7850	7830	6160
Chromium	-	-	-	-	-	-	-	-	-	7.9	-	-	-
Cobalt	-	-	7.7	-	-	-	7.9	5.1	-	-	-	-	-
Copper	122	21.6	19.2	26.7	71	9.5	24	23.9	55.9	73	19.4	17.7	11.6
Cyanide	-	-	-	-	-	-	-	-	-	-	-	-	
Iron	254	118	39.2	225	913	46.5	199	355	91.4	204	19.2	-	211
Lead	3.3	3.0	11.6	14.8	1.3	-	0.42	0.72	-	3.3	2.9	1.7	2.2
Magnesium	3190	2630	3300	2470	2900	2790	3210	3040	2670	2580	2770	2840	1670
Manganese	16	33.0	61.2	51.5	-	17.5	3.3	5.2	4.8	34	52	33.2	17.4
Mercury	0.6	-	-	-	0.5	-	-	-	-	0.4	-	-	-
Nickel	-	-	-	-	-	-	-	-	-	-	-	-	
Potassium	-	422	-	-	-	303	-	-	-	-	849	635	480
Selenium	-	-	-	-	-	-	-	-	-	-	-	1.4	-
Silver	-	-	-	-	6	-	-	-	-	-	7.0	-	4.9
Sodium	2910	1940	5200	-	4240	3475	7030	5510	2480	10100	13200	9200	5380
Thallium	-	-	-	-	-	-	-	-	-	-	-	-	
Tin	-	-	-	-	-	-	-	-	-	-	-	-	
Vanadium	-	-	5	-	-	-	6.7	4.9	-	-	-	-	-
Zinc	21	20	20.8	8.4	149	28.4	8.4	12.3	4.1	30	18.6	19.5	30.4

aResults from HART sampling.
- Not detected.

Table 3-52 (continued)

USEPA Residential Well Sampling Results
C & D Recycling Site Remedial Investigation

Analyte	Jane Salina				
	10/88	1/89	4/3/89*	4/27/89*	6/89*
Aluminum	1280	1590	1400	1660	1210
Antimony	-	-	-	-	-
Arsenic	-	-	-	-	-
Barium	-	73.8	62.2	66.4	50.3
Beryllium	-	-	-	1.7	-
Cadmium	13	-	-	-	-
Calcium	3750	3450	3190	3800	3060
Chromium	-	-	-	-	-
Cobalt	-	18.3	21.5	27.8	7.1
Copper	80	11.9	1470	19.5	26.7
Cyanide	-	-	-	-	-
Iron	1770	66.7	13.8	391	3.7
Lead	6.8	5.8	14.2	5.8	2.7
Magnesium	1240	1050	1230	1530	647
Manganese	489	475	644	505	375
Mercury	0.4	-	0.2	-	-
Nickel	-	-	-	-	-
Potassium	1000	1180	6830	6950	-
Selenium	-	-	-	-	-
Silver	23	-	-	-	-
Sodium	12400	14700	13100	14700	6880
Thallium	-	-	-	-	-
Tin	-	-	-	-	-
Vanadium	-	-	6.1	10	-
Zinc	60	57.2	148	62.5	68

*Results from HART sampling.
- Not detected.

APPENDIX 8
SOIL DESCRIPTION
FORM F

From:
Commonwealth of Pennsylvania
Department of Environmental Resources
Bureau of Waste Management

ER—WM—371: 4/92

Date Prepared/Revised

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WASTE MANAGEMENT

I.D. Number

FORM F
SOILS INFORMATION — PHASE I

General References: 273.117, 277.117, 288.124, 289.124
If additional space is required attach the information on 8½ x 11 inch sheets of paper. Identify each attached sheet by reference to Form F and the appropriate section.

A. List each soil series on and contiguous to the site.

Soil Series

1. OQUAGA AND LORDSTOWN CHANNERY SILT LOAMS
2.
3.
4.
5.

SEE APPENDIX 1C 5E AND 8A

B. A sufficient number of pits, excavations, and samples to allow an accurate characterization of the soils within the proposed permit area and adjacent area down to bedrock, and soils to be used for cover and facility construction are required. Include a narrative interpreting the information relative to site design. Attach the Form 2R map, which identify's the soil borrow areas on and off site, and identify all pits, excavations, and sampling locations by number or letter. SEE APPENDIX 5E

The soil descriptions must identify any perched water tables seasonal water tables, or regional water tables that may be encountered.

1. Attach pit or excavation descriptions written in the following format: Identify map reference number or letter.

Pit #	Depth	Color	Texture	Structure	Consistence	Mottling
Example:						
Pit #1	0"-12"	dark brown	sandy loam	granular	friable	none
	12"-24"	yellowish brown	silt loam	subangular blocky	firm	none
	24"-40"	brown	loam	prismatic	hard	grayish brown
	40"+	bedrock				
Pit #2	etc...					

SEE APPENDIX 6C (BORING LOGS)

AR313055

I.D. Number

2. Attach the laboratory particle size analyses and, if required, cation exchange capacity and organic carbon content, performed on samples from the backhoe pits or excavations, to determine acceptability of soils for cover material, clay cap, attenuating soil base, and liner system construction material. A representative sampling plan to be used during facility construction should be included. Identify map and excavation site for each analysis.

3. Identify the Unified Soil Classification System description of the soils to be used for the following purposes.

   Subbase ________ Design Related
   Clay liner ________
   Leachate detection zone ________ See FS Report
   Protective cover ________ &
   Clay cap ________
   Final cover drainage layer ________
   Other ________

   Attach testing results to support the classifications.

4. Identify the United States Department of Agriculture Soil Classification System description of the soils to be used for the following purposes. Include the percentage of fragments retained on the 2 mm No. 10 sieve and the particle size distribution for particles passing the 2mm, No. 10 sieve (% sand, % silt, % clay) for each soil use.

   Daily cover ________ Design Related
   Intermediate cover ________
   Final cover ________
   Attenuating soil base* ________
   Other ________

*Natural attenuation is an option for Class III and construction/demolition sites only. If natural attenuation is proposed for a construction/demolition site explain in detail how the constituents of the waste have no potential for surface or groundwater pollution.

5. Are the cover soils combustible? ☐ Yes ☒ No If yes, explain. ________

6. Identify the diameter in inches of the largest rock fragments within each borrow area for soils to be used for the following purposes.

   Subbase ________ Design Related
   Clay liner ________
   Leachate detection zone ________
   Protective cover ________
   Daily cover ________
   Intermediate cover ________
   Final cover ________
   Final cover drainage layer ________
   Clay cap ________
   Attenuating soil base ________
   Other ________

FORM F

I.D. Number

7. Identify the volume (cubic yards) of soil required for each construction purpose.

   Subbase ______ See FS REPORT

   Clay liner ______

   Leachate detection zone ______ §4.9

   Protective cover ______

   Clay cap ______ (DESIGN RELATED)

   Daily cover ______

   Intermediate cover ______

   Final cover ______

   Final cover drainge layer ______

   Attenuating soil base ______

   Other ______

   Attach plans and calculations to verify the volumes required.

8. Identify the volume (cubic yards) of acceptable soils available from each borrow area for each construction purpose:

   Subbase ______ SEE FS REPORT

   Clay liner ______ §4.9

   Leachate detection zone ______ (DESIGN RELATED)

   Protective cover ______

   Clay cap ______

   Daily cover ______

   Intermediate cover ______

   Final cover ______

   Final cover drainage layer ______

   Attenuating soil base ______

   Other ______

   Attach calculations, cross-sections, and plan drawings showing the locations of the cross-sections to verify the volumes available.

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APPENDIX 8A
ENGINEERING PROPERTIES OF SOIL

From:
Soil Survey for Luzerne County

TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Classification Unified
	Ft	*Ft*	*In*	*Pct*					
Dekalb: DdB, DdD, DEF	>6	1½–3½	0–6	0–30	50–85	40–75	35–65	15–55	SM, GM, ML
			6–21	10–40	50–85	40–80	40–75	20–55	ML, SM, GM
			21–28	10–50	45–85	35–75	25–65	15–40	SM, GM
			28						
Holly: Ho	0–½	>6	0–38	0	95–100	95–100	85–100	45–90	SM, SC, ML, CL
			38–60	0–10	70–100	65–100	55–100	30–85	ML, SM
Kedron: KdB, KdC, KeB, KeC, KwB, KxB.	½–3	>5	0–9	5–15	75–100	70–100	55–95	55–90	ML, CL
			9–22	5–15	80–100	75–100	60–100	40–95	ML, CL, SM, SC
			22–60	5–15	65–95	50–95	40–95	30–90	ML, CL, SM, SC, GM, GC
Klinesville. Mapped only with Weikert soils.	>6	1–½	0–9	5–15	45–75	40–75	20–50	12–40	GM, SM
			9–17	5–25	30–60	20–50	15–40	4–30	SM, GM, GP, SP
			17						
*Lackawanna: LaB, LaC, LaD, LcB, LcD, LEF. For Bath part of LEF, see Bath series.	>3	>6	0–17	0–20	60–80	50–75	35–70	20–60	SM, ML, GM
			17–60	0–20	50–80	40–75	35–55	20–40	GM, GC, SM, SC
Leck Kill: LkB, LkC, LkD	>6	3½–5	0–10	0–5	60–85	60–80	40–80	20–70	ML, GM, SM
			10–27	0–20	45–90	45–85	25–80	20–70	GM, ML, SC, SM
			27–48	0–25	30–70	20–55	15–45	15–35	GM, GC, SC
			48						
Linden: Ln	>3	>5	0–45	0–5	90–100	75–100	70–100	20–65	ML, SM
			45–60	0–15	40–100	35–100	35–80	5–35	GM, SM, SP-SM, GP-GM
Lordstown. Mapped only with Oquaga soils.	>6	1½–3½	0–8	0–15	60–80	55–75	30–55	25–45	SM, GM
			8–30	10–40	45–85	40–80	20–50	15–30	SM, GM, SC, GC
			30						
Mardin: MaB, MaC, MaD, McB, McD.	1½–3	>6	0–19	5–15	60–90	55–85	45–70	30–55	ML, SM, GM
			19–64	10–25	55–90	45–80	40–75	25–55	ML, GM, SM
Meckesville: MeB, MeC, MeD, MfB, MfD.	>3	>5	0–8	0–15	80–100	70–90	65–85	55–70	ML
			8–35	0–20	75–100	65–90	60–85	50–70	ML
			35–60	0–20	45–85	40–70	30–60	25–55	ML, SM, GM
Mine dump: Mg, Mh. Too variable to estimate. Requires onsite investigation.									

significant in engineering—Continued

Classification (cont.) AASHTO	USDA texture	Range in permeability	Range in available water capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosion potential	
								Steel	Concrete
		In/hr	*In/in of soil*	*pH*	*Pct*	*Lb/ft³*			
A-1, A-2, A-4	Channery sandy loam.	2.0-6.0	0.08-0.12	3.6-5.5			Low	Low	High.
A-1, A-2, A-4	Channery sandy loam.	2.0-6.0	0.06-0.12	3.6-5.5	10-15	115-123	Low	Low	High.
A-1, A-2, A-4	Very channery sandy loam.	2.0-6.0	0.05-0.10	3.6-5.5	9-13	115-125	Low	Low	High.
	Sandstone bedrock.								
A-4, A-6	Silt loam, very fine sandy loam.	0.2-2.0	0.16-0.20	5.1-6.5	10-18	105-110	Low	High	Moderate.
A-2, A-4	Silty clay loam, silt loam.	0.2-2.0	0.08-0.16	5.6-7.3	8-15	110-125	Low	High	Moderate.
A-4	Channery silt loam	0.6-2.0	0.14-0.20	3.6-5.5			Low	High	High.
A-4, A-6	Channery silt loam, silty clay loam.	0.2-2.0	0.08-0.14	3.6-5.5	12-16	105-120	Low	High	High.
A-2, A-4, A-6	Channery silt loam	0.06-0.2	0.06-0.10	3.6-5.5	10-16	105-125	Low	High	High.
A-1, A-2, A-4	Channery silt loam	2.0-6.0	0.08-0.12	4.5-5.5			Low	Low	High.
A-1, A-2	Very channery silt loam, channery silt loam.	2.0-6.0	0.04-0.08	4.5-5.5	11-15	114-120	Low	Low	High.
	Shale bedrock.								
A-1, A-2, A-4	Channery silt loam, channery loam.	0.6-2.0	0.10-0.14	4.5-5.5	11-16	110-122	Low	Low	High.
A-1, A-2, A-4	Channery silt loam, channery loam.	0.06-0.2	0.06-0.14	4.5-6.0	10-14	114-124	Low	Low	High.
A-1, A-2, A-4	Channery silt loam	0.6-6.0	0.14-0.20	4.5-7.0			Low	Low	High.
A-1, A-2, A-4, A-6	Channery silty clay loam.	2.0-6.0	0.12-0.16	4.5-6.5	11-16	112-120	Low	Low	High.
A-1, A-2, A-4	Very channery silt loam.	2.0-6.0	0.04-0.08	4.5-6.0	11-16	110-122	Low	Low	High.
	Shale bedrock.								
A-2, A-4	Silt loam, very fine sandy loam, sandy loam.	2.0-6.0	0.14-0.18	3.6-6.0	12-16	110-120	Low	Low	High.
A-1, A-2	Very gravelly sand	2.0-6.0	0.05-0.10	3.6-6.0	10-16	112-120	Low	Low	High.
A-2, A-4	Channery silt loam	0.6-2.0	0.06-0.10	4.5-6.5			Low	Low	High.
A-1, A-2	Channery silt loam, very channery silt loam.	0.6-2.0	0.06-0.10	4.5-6.0	9-13	117-125	Low	Low	High.
	Shale bedrock.								
A-2, A-4	Channery silt loam, channery loam.	0.6-2.0	0.10-0.14	4.5-6.0	10-15	110-125	Low	Moderate	High.
A-2, A-4	Channery loam	0.06-0.2	0.06-0.10	4.5-6.5	8-12	115-125	Low	Moderate	High.
A-4	Channery silt loam	0.6-2.0	0.14-0.18	3.6-5.0			Low	Low	High.
A-4	Silt loam, channery silt loam.	0.6-2.0	0.12-0.16	3.6-5.0	12-15	105-115	Low	Low	High.
A-2, A-4	Channery silt loam	0.2-0.6	0.08-0.12	3.6-5.0	11-14	115-125	Low	Low	High.

significant in engineering—Continued

Classification (cont.) AASHTO	USDA texture	Range in permeability	Range in available water capacity	Reaction	Optimum moisture for compaction	Maximum dry density	Shrink-swell potential	Corrosion potential: Steel	Corrosion potential: Concrete
		In/hr	*In/in of soil*	*pH*	*Pct*	*Lb/ft³*			
A-4	Channery silt loam, loam.	0.6-2.0	0.10-0.16	4.5-6.0	10-14	118-122	Low	High	High.
A-2, A-4, A-6	Channery silt loam, channery loam.	0.06-0.2	0.06-0.08	4.5-6.5	10-13	116-122	Low	High	High.
A-8	Muck, mucky peat	2.0-6.0	0.20-0.30	3.6-5.5			High	High	High.
A-2, A-4	Channery silt loam	0.6-2.0	0.10-0.16	4.5-5.5			Low	Low	High.
A-1, A-2, A-4	Channery silt loam, channery loam, very channery loam.	0.6-2.0	0.06-0.10	4.5-5.5	10-16	115-125	Low	Low	High.
	Shale bedrock.								
A-1, A-2	Gravelly sandy loam.	2.0-6.0	0.10-0.16	3.6-5.5			Low	Low	High.
A-1, A-2	Gravelly loam	0.6-2.0	0.08-0.14	3.6-5.5	10-15	116-124	Low	Low	High.
A-4	Silt loam	0.6-6.0	0.12-0.16	3.6-5.5			Low	Low	High.
A-1, A-2, A-4	Silt loam, loam	2.0-6.0	0.12-0.16	3.6-5.5	10-15	105-115	Low	Low	High.
A-4	Loam	0.6-2.0	0.14-0.18	4.5-6.0	15-21	100-112	Low	High	High.
A-4	Loam	0.06-0.2	0.06-0.10	5.1-6.5	15-21	100-112	Low	High	Moderate.
A-2, A-4	Gravelly loam, very gravelly loamy sand.	0.06-2.0	0.04-0.08	5.1-6.5	10-16	116-122	Low	High	Moderate.
A-4, A-6	Silt loam, gravelly silt loam.	0.2-0.6	0.14-0.18	3.6-5.5			Low	High	High.
A-4, A-6	Gravelly clay loam	0.06-0.2	0.10-0.14	3.6-5.5	11-14	114-122	Low	High	High.
A-4	Channery silt loam	0.6-2.0	0.14-0.18	4.5-6.5			Low	High	High.
A-4	Channery loam	<0.06	0.08-0.12	5.6-6.5	12-16	110-118	Low	High	Moderate.
A-4, A-6	Silt loam, silty clay loam.	0.06-0.2	0.14-0.20	6.6-7.8	15-20	103-111	Low	High	High.
A-1, A-2, A-4	Channery silt loam	2.0-6.0	0.08-0.14	4.5-5.5			Low	Low	High.
A-1, A-2	Channery silt loam, very channery silt loam.	2.0-6.0	0.04-0.08	4.5-5.5	11-15	115-122	Low	Low	High.
	Shale bedrock.								
A-4	Channery silt loam, gravelly silt loam.	0.2-2.0	0.10-0.14	4.5-6.0	10-15	110-120	Low	Moderate	High.
A-2, A-4	Channery silt loam	0.06-0.2	0.06-0.10	4.5-6.0	5-15	115-130	Low	Moderate	High.

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TABLE 7.—*Estimated soil properties*

Soil series and map symbols	Depth to— Seasonal high water table	Depth to— Bedrock	Depth from surface (typical profile)	Coarse fraction greater than 3 inches	Percentage passing sieve— No. 4 (4.7 mm)	No. 10 (2.0 mm)	No. 40 (0.42 mm)	No. 200 (0.074 mm)	Classification Unified
	Ft	*Ft*	*In*	*Pct*					
Mine wash: Mm. Too variable to estimate. Requires onsite investigation.									
Morris: MoB, MoC, MsB, MsC.	½–1½	>5	0–16	0–20	60–95	55–90	45–85	40–65	ML, SM, GM
			16–60	0–20	60–95	50–90	40–85	35–70	ML, GM, SM
Muck: Mu	0	>5	0–68	0					Pt
*Oquaga: OlB, OlC, OlD, OpB, OpD, OXF. For Lordstown part, see Lordstown series.	>6	1½–3½	0–9	0–15	40–75	35–75	30–55	25–45	GM, SM, GC, SC
			9–35	5–15	35–75	20–75	20–60	15–50	SM, GM
			35						
Pocono: PoB, PoC, PpB, PpD.	>6	>6	0–5	0–5	55–80	45–75	40–60	20–30	GM, SM
			5–65	0–15	55–80	35–75	35–50	20–35	GM, SM
Pope: Ps	>3	>6	0–10	0	80–100	75–100	55–85	40–65	ML, SM
			10–62	0–5	50–100	50–100	40–100	20–90	ML, SM, GM
Rexford: RdA, RdB	½–1½	>6	0–18	0	85–100	80–100	70–90	45–70	ML, SM
			18–37	0	85–100	80–100	70–100	45–95	ML, SM
			37–60	0–20	60–90	55–80	40–70	25–55	ML, SM, GM
Shelmadine: ShA, SkB	0–½	>5	0–20	0–5	80–100	70–95	60–90	50–80	ML, CL
			20–60	0–10	0–90	60–90	55–80	45–65	ML, CL, GM, GC, SM, SC
Strip mine: Sm. Too variable to estimate. Requires onsite investigation.									
Urban land: Ub, Uf. Too variable to estimate. Requires onsite investigation.									
Volusia: VoB, VoC, VrB, VrC.	½–1½	>6	0–20	5–15	70–95	65–90	60–85	45–70	ML, GM, SM
			20–60	5–25	65–90	55–80	50–75	40–65	ML, CL, SM, GM
Wayland: Wa	0	>5	0–60	0	95–100	90–100	90–100	70–90	ML, CL
*Weikert: WeB, WeC, WeD. For Klinesville part, see Klinesville series.	>6	1–1½	0–8	0–10	40–70	35–65	25–65	20–55	GM, ML, SM
			8–17	0–20	25–55	20–50	10–35	5–30	GM, GP, SM
			17						
Wellsboro: WlB, WlC, WlD, WmB, WmD.	1½–3	>6	0–22	0–15	70–95	65–90	60–85	40–70	ML, SM, GM
			22–72	0–20	55–90	45–90	35–80	25–60	ML, GM, SM

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APPENDIX 9
SURFACE WATER INFORMATION

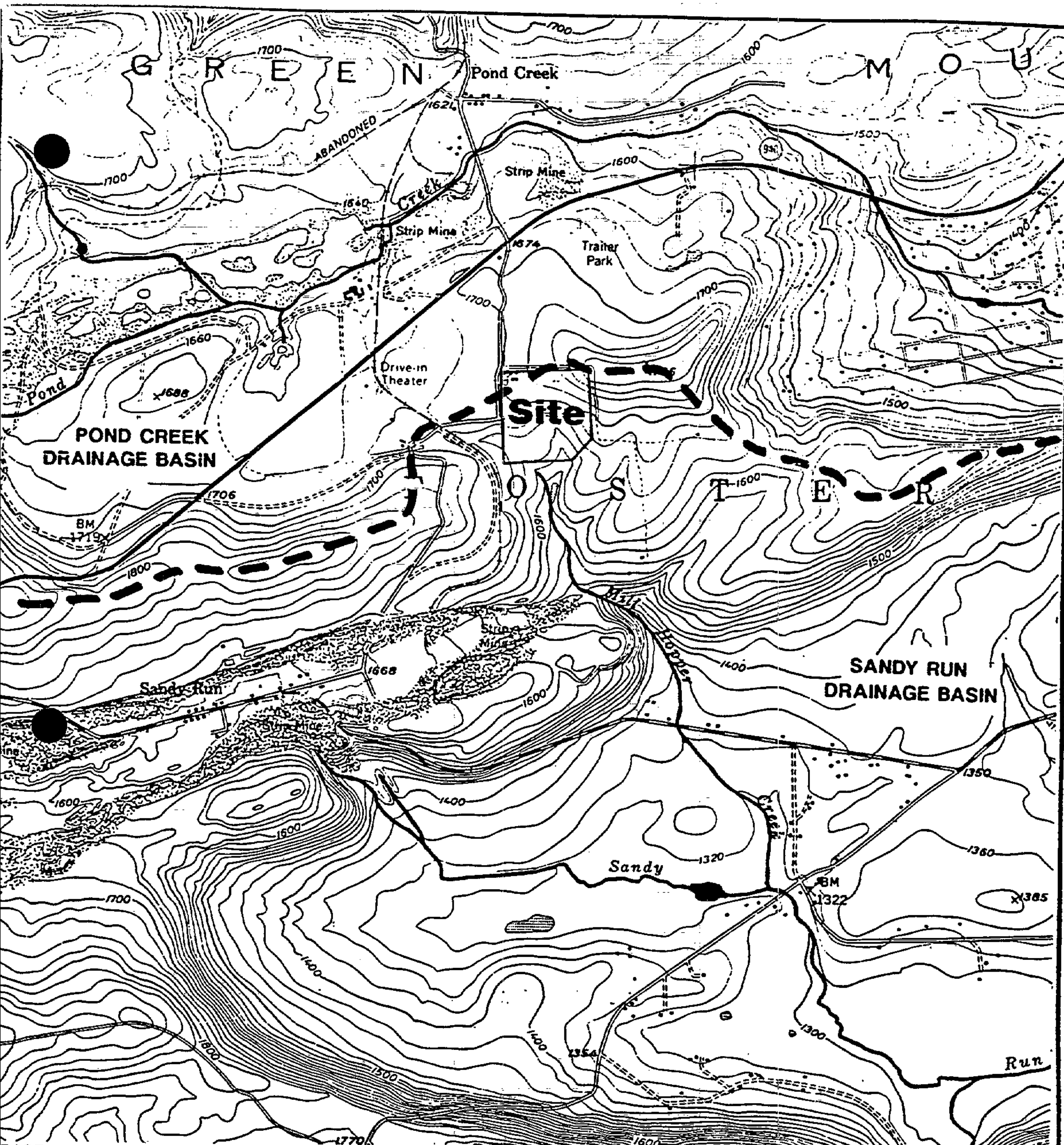
RI Sections 2.3
RI Figures 2-2, 2-3

2.3 Surface Water Hydrology and Quality

Surface waters in the vicinity of the Site include ponds, swamps, streams, and water filled surface mines. Sandy Run, located one mile south of the Site, flows east and is a major northwest tributary of the Lehigh River. Sandy Run is fed by south flowing Mill Hopper Creek whose headwaters are in the southern portion of the Site. Pond Creek, also a tributary to Sandy Run, flows east and is located approximately one-half mile north of the Site.

The topography of the area indicates that the Site is located within the Pond Creek and Mill Hopper Creek drainage basins. A surface water divide which trends northeast/southwest causes surface water in the extreme northwestern part of the Site to drain toward Pond Creek while surface water from the rest of the Site drains toward Mill Hopper Creek. The locations of these streams and the drainage divide in relation to the Site are shown in Figure 2-2. The conceptualized surface water migration pathways at the Site are shown in Figure 2-3. An intermittent stream is present in the southern portion of the Site. This stream bed is fed by surface runoff from the majority of the Site, including the shale pit. Seasonal springs and seeps from a bank just south of the old farmhouse ruins and an old artesian well just east of the shale pit also feed this stream. The stream flows into a man-made pond just south of the Site at an elevation of approximately 1608 feet (MSL). There is an earthen embankment at the southern edge of this pond which regulates surface water outflow into Mill Hopper Creek. Outflow from the pond may cease in dry periods during the year.

Surface water from Mill Hopper Creek was analyzed in September and October of 1984 by PADER (see Section A3 of Appendix A). The laboratory analytical results indicated that the metals copper and lead were not present in detectable concentrations. Note that these data could not be validated because of a lack of Quality Assurance/Quality Control information. Additionally, the pH of the water in Mill Hopper Creek was 6.1 and 6.2, which is slightly below the normal range of 6.5 to 8.5. The low pH may be due to the effects of acid rain or the pH of the soils in the drainage basin. The Soil Survey of Luzerne County, PA indicates that these soils are slightly to very strongly acidic (pH 4.5 to 6.5).



BASE MAP: U.S.G.S. 7.5' QUAD., WHITE HAVEN, PA (1947)

CONTOUR INTERVAL: 20 FT.

DRAINAGE DIVIDE

1000 0 1000 2000

scale in feet

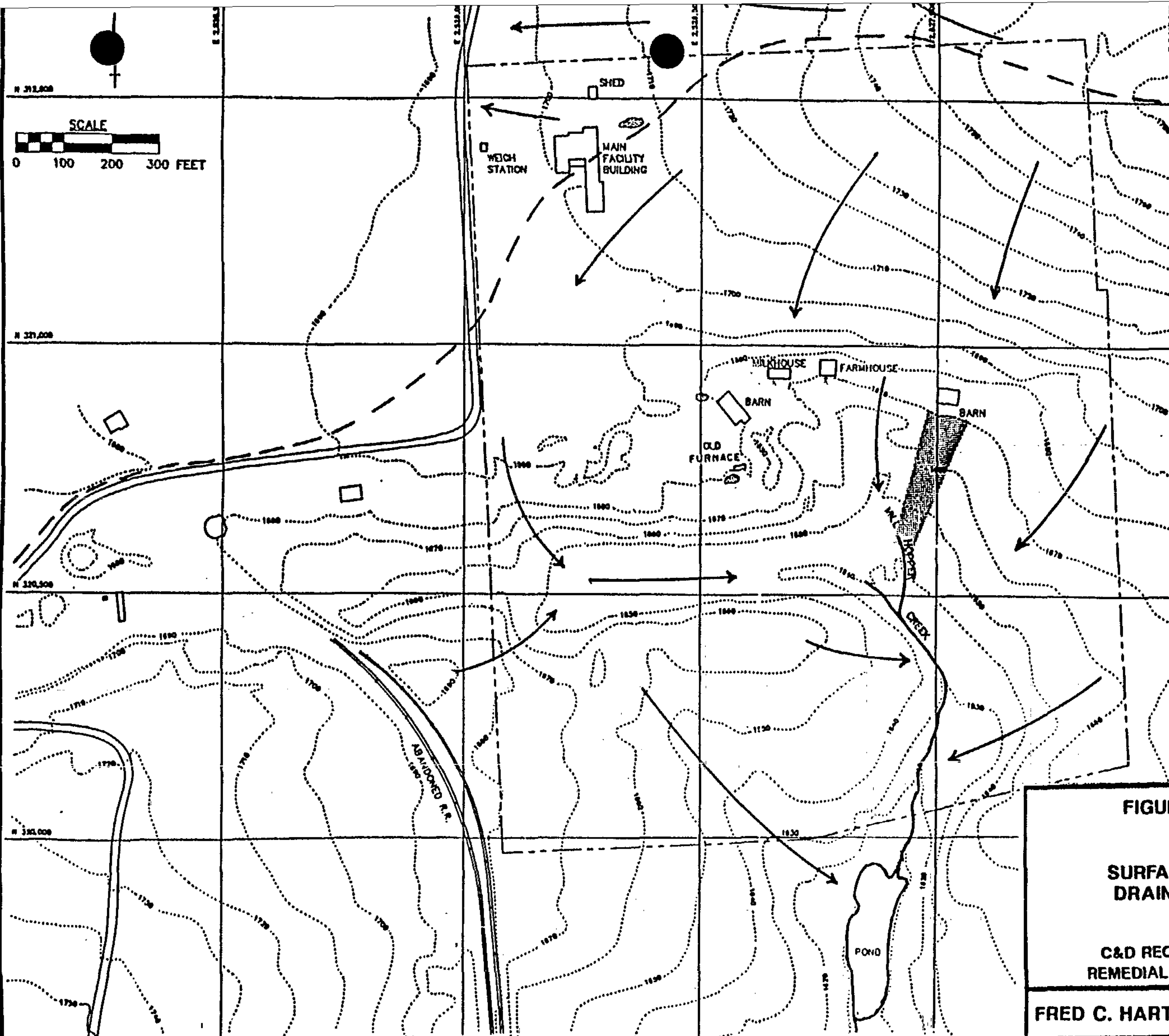
N

FIGURE 2-2

DRAINAGE BASINS IN THE VICINITY OF THE SITE

C&D RECYCLING SITE
REMEDIAL INVESTIGATION

FRED C. HART ASSOCIATES, INC.



LEGEND

SURFACE WATER DRAINAGE DIVIDE

SURFACE WATER FLOW PATHWAY

CONTOUR INTERVAL: 10 FT.

SOURCE: AERIAL PHOTOGRAPH SURVEY EASTERN MAPPING APRIL 21, 1987

FIGURE 2-3

SURFACE WATER DRAINAGE MAP

C&D RECYCLING SITE REMEDIAL INVESTIGATION

FRED C. HART ASSOCIATES, INC.

As mentioned in Section 2.1, several coal mines are located near the Site. This activity has resulted in the production of acid mine water which has affected Pond Creek and Sandy Run. Oxidation of pyrite and marcasite, common minerals in coal, forms sulfuric acid in surface runoff waters which lowers the pH of the receiving surface water body. Acidic surface runoff water also increases the amount of dissolved solids and a number of metals, including iron, manganese and aluminum (McCarren, 1969; Taylor, 1984). For example, water samples obtained from Sandy Run and Pond Creek on July 12, 1960 had pH values of 3.4 and 4.3, respectively (McCarren, 1969). Total dissolved solids and metal concentrations in Lehigh River surface water samples are consistently higher at locations downstream of mine drainage influent when compared to upstream surface water locations (McCarren, 1969).

In Pond Creek, a pH reading of 5.4 was measured by HART in February 1989 at the bridge just downstream from the abandoned strip mine northwest of the Site. A light iron precipitate, indicative of acid mine drainage, was observed covering the rocks in the streambed. pH readings in the surface mine ponds which feed Pond Creek ranged from 4.3 to 4.9 when measured by HART in November 1988 and February 1989.

2.4 Geology

Rock formations exposed in the region range from Devonian shales of the Hamilton Group (oldest) to the Pennsylvanian Llewellyn Formation (youngest). These sedimentary rocks range from hard, coarse-grained conglomerates to soft, fine-grained shales. Pennsylvanian Formations (Pottsville and Llewellyn) contain coal-bearing units. A description of the composite stratigraphic sections for Luzerne County (Newport, 1977) is displayed as Table 2-1.

APPENDIX 9A
SURFACE WATER SAMPLE LOCATIONS AND ANALYTICAL RESULTS

RI Figures 3-3
RI Tables 3-4 and 3-5a
Technical Memorandum #2 Table 1 and 2
Results Report

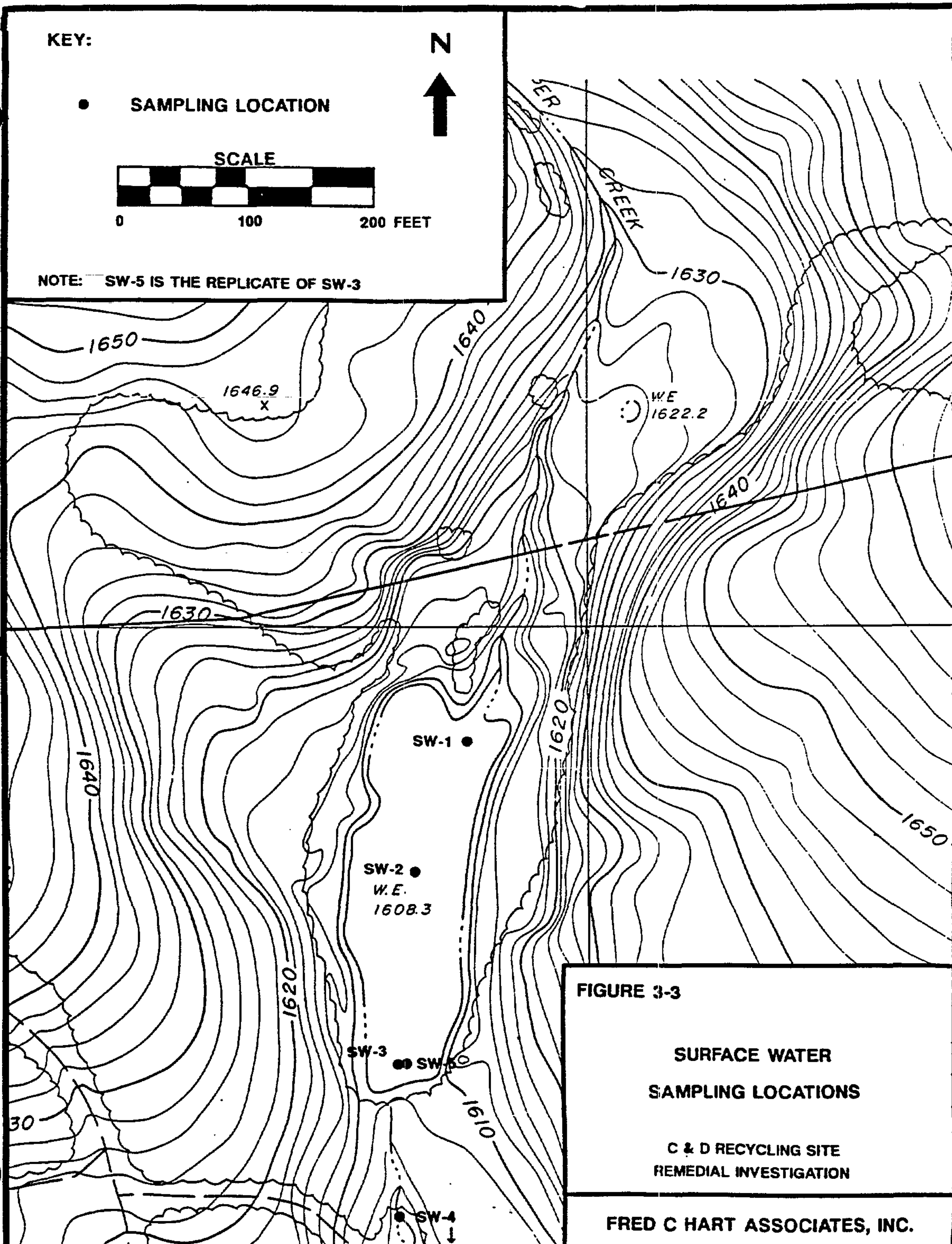


FIGURE 3-3

SURFACE WATER SAMPLING LOCATIONS

C & D RECYCLING SITE
REMEDIAL INVESTIGATION

FRED C HART ASSOCIATES, INC.

TABLE 3-4

Surface Water Sampling and Field Parameter Information
C & D Recycling Site
Remedial Investigation

Sample #	Sampling Location	pH	Temperature (°C)	Specific Conductivity (mmhos/cm)*	Split Sample with VERSAR
SW-1	inflow of pond	7.52	21.2	.050	
SW-2	center of pond	8.44	16.3	.052	
SW-3	outflow of pond	8.10	24.0	.051	X
SW-4	300 ft. downstream of pond	5.88	14.2	.042	

* Corrected to 25° C.

NOTES:

- Sample numbers include both filtered and unfiltered samples
- Field parameters obtained for unfiltered samples
- Sample SW-5, filtered and unfiltered, was a replicate of location SW-3 and was also split with VERSAR.
- Obtained one field blank, filtered and unfiltered, and split with VERSAR.

TABLE 3-5a

List of Analytical Parameters: Surface Water Samples
C & D Recycling Site
Remedial Investigation

Inorganics	Detection Limits (µg/L)
Antimony	60
Arsenic	10
Beryllium	5
Cadmium	5
Chromium	10
Copper	25
Lead	3
Mercury	0.2
Nickel	40
Selenium	5
Silver	10
Thallium	10
Zinc	20
Cyanide	10
Total Phenols	10

Pesticide Organics	Detection Limits (µg/L)
alpha-BHC	0.05
beta-BHC	0.05
delta-BHC	0.05
gamma-BHC (Lindane)	0.05
Heptachlor	0.05
Aldrin	0.05
Heptachlor epoxide	0.05
Endosulfan I	0.05
Dieldrin	0.10
4,4'-DDE	0.10
Endrin	0.10
Endosulfan II	0.10
4,4'-DDD	0.10
Endosulfan sulfate	0.10
4,4'-DDT	0.10
Methoxychlor	0.50
Endrin ketone	0.10
alpha-Chlordane	0.50
gamma-Chlordane	0.50
Toxaphene	1.00
Aroclor-1016	0.50
Aroclor-1221	0.50
Aroclor-1232	0.50
Aroclor-1242	0.50
Aroclor-1248	0.50
Aroclor-1254	1.00
Aroclor-1260	1.00

Semivolatile Organics	Detection Limits (µg/L)
Phenol	10
bis(2-Chloroethyl)Ether	10
2-Chlorophenol	10
1,3-Dichlorobenzene	10
1,4-DichlorobenzenE	10
Benzyl Alcohol	10
1,2-Dichlorobenzene	10
2-Methylphenol	10
bis(2-Chloroisopropyl)Ether	10
4-Methylphenol	10
N-Nitroso-Di-n-Propylamine	10
Hexachloroethane	10
Nitrobenzene	10
Isophorone	10
2-Nitrophenol	10
2,4-Dimethylphenol	10
Benzoic Acid	50
bis(2-Chloroethoxy)Methane	10
2,4-Dichlorophenol	10
1,2,4-Trichlorobenzene	10
Naphthalene	10
4-Chloroaniline	10
Hexachlorobutadiene	10
4-Chloro-3-Methylphenol	10
2-Methylnaphthalene	10
Hexachlorocyclopentadiene	10
Benzo(g,h,i)Perylene	10
2,4,6-Trichlorophenol	10
2,4,5-Trichlorophenol	50
2-Chloronaphthalene	10
2-Nitroaniline	50
Dimethyl Phthalate	10
Acenaphthylene	10
2,6-Dinitrotoluene	10
3-Nitroaniline	50
Acenaphthene	10
2,4-Dinitrophenol	50
4-Nitrophenol	50
Dibenzofuran	10
2,4-Dinitrotoluene	10
Diethylphthalate	10
4-Chlorophenyl-phenylether	10
Flourene	10
4-Nitroaniline	50
4,6-Dinitro-2-Methylphenol	50
N-Nitrosodiphenylamine (1)	10
4-Bromophenyl-phenylether	10
Hexachlorobenzene	10
Pentachlorophenol	50
Phenanthrene	10
Semivolatile Organics	10
Anthracene	10
Di-n-Butylphthalate	10
Fluoranthene	10
Pyrene	10
Butylbenzylphthalate	10
3,3'-Dichlorobenzidine	20
Benzo(a)Anthracene	10
Chrysene	10
bis(2-Ethylhexyl)Phthalate	10
Di-n-Octyl Phthalate	10
Benzo(b)Fluoranthene	10
Benzo(k)Fluoranthene	10
Benzo(a)Pyrene	10
Indeno(1,2,3-cd)Pyrene	10
Dibenz(a,h)Anthracene	10

Table 3-5b

Summary of Valid Analytical Results--Surface Water Samples
C & D Recycling Site Remedial Investigation

Parameter	PA Fish and Aquatic Life Criteria*** Continuous	PA Fish and Aquatic Life Criteria*** Maximum	SW-1	SW-1F	SW-2	SW-2F	SW-3	SW-3F	SW-4	SW-4F	SW-5(rep)	SW-5F(rep)	FB-1	FB-1F
Metals:														
Arsenic	190	360	--	--	--	--	--	--	--	--	1.5**	--	--	--
Berylium	.01(96 hr LC50)	.05(96 hr LC50)	--	--	--	--	--	--	--	--	6.7	--	--	--
Cadmium	0.66	1.8	--	--	--	--	--	--	--	--	8.8	--	--	--
Chromium	131	996	--	--	--	--	--	--	--	--	7.2**	--	--	--
Copper	6.5	9.2	54	--	--	--	--	--	--	--	--	--	--	--
Lead	1.3	34	57	5.4	22	3.9**	20	4**	27	6	32	4.6**	--	--
Silver	0.2	1.2	--	--	--	--	--	--	--	--	4.4**	--	--	--
Zinc[1]	59	65	52*	18**	23*	20*	25*	23*	17*	20*	7.2**	25*	8.1**	11*
Organics:														
bis(2-Ethylhexyl)phthalate			--	--	--	--	7*	--	5**	--	5**	--	--	--

* Estimate only.
** Value below Contract Required Detection Limit.
*** Pennsylvania Water Quality Standards; Pennsylvania Code, Title 25 - Environmental Resources, Chapter 16 - Water Quality Toxics Management Strategy - Statement of Policy, Adopted 03/10/89, Amended 04/07/89; and Chapter 93 - Water Quality Standards; Adopted 09/02/71; Amended 06/24/89.
-- Compound Not Detected.
F =Filtered Sample
FB =Field blank
rep=SW-5 is replicate of SW-3; SW-5F is replicate of SW-3F
All units are parts per billion (ppb).
All parameters from Table 3-5a not shown in the table were not detected in any sample.

[1] *Note: Under the validation guidelines in force at the time these samples were analyzed, the zinc concentrations in any sample below 5 times the highest concentration found in any blank were to be qualified as estimates. Under current validation guidelines, these concentrations would be considered as not detected at a detection limit of 55 ppb.*

AR313068

Table 1
Additional Sampling and Analytical Parameters
C&D Recycling Site
November 1991

Soil/Sediment Sample Designation	Interval			Analyte					Duplicate
	0 to 1 inch	1 to 6 inch	0 to 6 inch	Sb	Cu	Pb	Ag	Zn	
B,1100			X	X	X	X	X	X	
D,1100			X	X	X	X	X	X	
F,1100	X	X	-	X	X	X	X	X	X
H,300	X	X	-	-	-	X	-	-	
H,300	X	-	-	-	-	X	-	-	X
H,600	X	X	-	-	-	X	-	-	
K,1100	X	X	-	-	-	X	-	-	
DA-21-5[1]	-	-	X	-	-	X	-	-	
DA-21-W5[1]	X	-	-	-	-	X	-	-	
DA-21-W5	-	-	X	X	X	X	X	X	
HH-01[1]	X	-	X	-	-	X	-	-	
HH-02[1]	X	-	X	-	-	X	-	-	
L;1300[1]	X	-	X	-	-	X	-	-	
D;1300[1]	X	-	X	-	-	X	-	-	
RB-01	-	-	-	X	X	X	X	X	

Surface Water Sediment Sample Designation	Location			Analyte							Duplicate
	South Pond	1000 Ft Down Stream	2500 Ft Down Stream	Hard ness	PAHs	Sb	Cu	Pb	Ag	Zn	
SW-01	-	-	X	X	X	X	X	X	X	X	
SW-02	-	X	-	X	X	X	X	X	X	X	
SW-03	-	-	X	X	X	X	X	X	X	X	X
SW-04	X	-	-	X	X	X	X	X	X	X	
CS-01[2]	-	-	X	-	-	X	X	X	X	X	

Notes:
1) Splits of USEPA sample locations
2) Sediment sample taken at location SW-01

AR313069

TABLE 2
SUMMARY OF VALID ANALYTICAL RESULTS
SURFACE WATER AND SEDIMENT
C&D RECYCLING SITE
NOVEMBER 1991

Parameter	SW-01 911118C-01	SW-02 911118C-02	SW-03* 911118C-03	SW-04 911118C-04	RB-01 911118C-10	CS-01[2] 911118C-01
Antimony (UG/L)	< 34.0	< 34.0	< 34.0	< 34.0	< 34.0	< 3.0R
Copper (UG/L)	< 6.0	< 6.0	< 6.0	57.4J	< 6.0	60.1J
Lead (UG/L)	1.6Q	< 1.0	< 1.0	60.0	< 1.0	165.0J
Silver (UG/L)	< 3.0	< 3.0	< 3.0	< 3.0	< 3.0	0.50Q
Zinc (UG/L)	18.5Q	12.1Q	12.3Q	43.1J	11.9Q	65.9J
Hardness (mg/L)	12	16	11	18	NA	NA

Notes:

< = Less than implies the sample was below detection.
NA = Not Analyzed
* = Duplicate of Sample SW-01
Q = Qualitative Only
J = Qualitative and Semi-Qualitative
1) = Rinsate Blank
2) = CS = Creek sediment at location of SW-01 approximately 2500 feet downstream of pond.

APPENDIX 10
ALTERNATIVE WATER SUPPLY INFORMATION
FORM 11R

From:
Commonwealth of Pennsylvania
Department of Environmental Resources
Bureau of Waste Management

ER-WM-369: 5/92

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF ENVIRONMENTAL RESOURCES
BUREAU OF WASTE MANAGEMENT

Date Prepared/Revised

I.D. Number

FORM 11R
ALTERNATIVE WATER SUPPLY - PHASE 1

General References: Sections 288.126, 289.126, 291.207

Facility Name: ______________________________

County: ____________________ Municipality: ____________________

Instructions: This form must be completed in its entirety by all applicants for residual waste landfills and residual waste disposal impoundments.

A narrative should address the following and must be provided on attached 8½ by 11 inch sheets. A water supply includes existing, currently designated, or currently planned sources of water or facilities or systems for the supply of water for human consumption or agricultural, commercial, industrial, or other legitimate use within one-quarter mile of the perimeter of the permitted disposal area.

1. Identify all public or private water supplies within one-quarter mile of the perimeter of the permitted disposal area.

2. Are there any current pollution, degradation, or diminution problems associated with the proposed facility?
   ☐ Yes ☐ No If yes, explain.

3. Provide a detailed hydrogeologic description of the position of the proposed permit area within the relevant groundwater flow systems (those which are sources for any water supply).

4. Describe the proposed facility's potential effect on any public or private water supply.

5. What will be the maximum impact on public/private water supplies should all the protective safeguards fail in the event of a breach of the liner/collection system?

6. How do the hydrogeologic characteristics of the proposed permit area and adjacent area assure that any groundwater contamination will be detected before it can degrade a public or private water supply?

7. Determine the feasibility of permanently replacing or restoring affected water supplies to like quantity and quality of the existing supply.

8. Describe the means of replacing or restoring affected water supplies.

SEE NARRATIVE IN REPORT SECTION 3.1.11.1

AR313072

APPENDIX 10A
LEACHING POTENTIAL EVALUATION

FS Section 2.0
FS Tables 2-1 and 2-2

2.0 REMEDIAL ACTION OBJECTIVES

USEPA RI/FS guidance stipulates development of remedial action objectives in order to determine the extent of cleanup which is necessary at a site. Remedial action objectives consist of medium-specific or operable unit specific goals to protect human health and environment. In accordance with SARA (1986) the remedial actions that are considered to meet these objectives must at least attain applicable or relevant and appropriate requirements (ARARs). By definition, ARARs are promulgated or legally enforceable federal and state requirements. In instances where there are no promulgated or legally enforceable requirements, remediation goals for protection of human health and the environment can be developed. The remediation goal would generally reflect the chemical of potential concern, exposure route(s) and receptor(s) and acceptable concentration or range concentration for each exposure route.

Any remedial action objective which reflects a promulgated or legally enforceable chemical concentration may be defined as a chemical-specific ARAR. Additional ARARs may be based on the site location or pertain to a technology considered for remediation. These ARARs are referred to as location specific and action specific, respectively. The purpose of ARARs is to provide protection to human health and the environment and comply with related federal and state laws or guidelines. If a proposal remedial technology or remedial alternative does not comply with identified ARARs, it can be summarily dismissed from consideration unless justification is provided to permit the ARAR to be waived.

The State of Pennsylvania has completed an advisory document which presents standards and requirements for cleanup related activities at waste sites in the Commonwealth of Pennsylvania. The advisory document is entitled, Applicable or Relevant and

Appropriate Requirements (ARARs) for Cleanup Response and Remedial Actions in Pennsylvania (Final, April 1991). The standards and requirements included in the Pennsylvania ARAR document are considered as chemical, action and/or location-specific ARARs in this FS.

In the case of protection of human health, remedial action objectives usually reflect a concentration and exposure route since protectiveness may be achieved by reducing exposure (eg. capping, or limiting access) as well as by reducing concentrations. Remedial action objectives which are established for protection of environmental receptors are usually intended to preserve or restore a resource. As such, environmental remedial action objectives are set for a medium of interest and target concentration level.

A final category of requirements, known as "to be considered" (TBCs), may be also used in evaluating ways to achieve a remedial action objective. TBCs may include nonpromulgated criteria, advisories, guidance, and proposed standards issued by federal or state governments. However, TBCs are not potential ARARs because they are neither promulgated nor enforceable. Therefore, identification and compliance with TBCs is not mandatory in the same way that it is for ARARs.

PADER maintains that groundwater must be remediated to "background" quality pursuant to 25 Pa Code Section 264.90 through 264.100, in particular by 25 Pa Code Section 264.90(i), (j) and 264.100 (a) (9). Although the statutory basis referenced for the requirement to remediate to "background" quality has not been officially proposed by PADER or accepted by USEPA Region III, this potential ARAR has been considered at other Pennsylvania sites. As previously stated, the results of the RI and evaluations in the RA do not support establishing remedial action objectives for groundwater at the Site. The multiple sampling, both on-site and off-site, indicate that the Site has not impacted groundwater. The groundwater quality in the area is influenced by regional features which are responsible for fluctuations in water quality. Furthermore, the chemicals of potential concern in groundwater were not attributed to leaching from the Site soils. Any calculated potential risks associated with these chemicals of potential concern in groundwater were influenced by the specified USEPA procedures for conducting RA which assigned concentration levels for selected chemicals when a non-detect value was reported. These facts, combined with the characterization in the RI, support the conclusion that groundwater has not been impacted by the Site. Therefore, there is no basis for selecting remedial action objectives or assigning chemical specific ARARs or remedial goals for groundwater at the Site.

The potential ARAR, which PADER maintains for groundwater remediation to "background" quality, could also apply to residual concentrations of chemicals of concern in soil and sediment after remediation. However, the likelihood that post remedial conditions would result in chemicals of concern leaching from soil or sediment to groundwater in the future is remote. This is supported by the fact that existing data indicates existing conditions have not impacted groundwater. A period of approximately 25 years has passed during which time either copper and lead recovery operations took place or the Site has existed in its current state. Given that this period of time has not resulted in an adverse impact to groundwater in excess of federal or state ARARs, there is no basis to conclude that such an impact could occur in the future as a result of precipitation leaching organic compounds and/or inorganic constituents from soil.

The types of organic compounds and inorganic constituents identified in soils at the Site exhibit a potent affinity to adsorb onto soil and sediment particles. This was evident from the comparison of analytical results of filtered and unfiltered surface and groundwater samples. In the case of organic compounds, adsorption onto soil/sediment particles can be defined as the concentration of a chemical adsorbed onto soil to its concentration in solution. The solution being the liquid which leaches from the soil as a result of the infiltration of precipitation. This expression is typically referred to as the adsorption coefficient (K_d).

Further evidence that the organic compounds identified in soils at the Site exhibit properties which promote binding onto soil particles was presented in Table 4-1 of the RI report. This table provided K_d values (referred to as K_{oc}) for most of the organic compounds found in on-site soils. For comparison purposes, the K_d for trichloroethylene, a volatile organic compound which exhibits a greater potential to leach to groundwater, was included on the table although it was not found at the Site. It was apparent from the information provided on this table that the possibility of organic compounds present in soils at the Site to leach to groundwater was remote. The K_d values for the detected organic compounds were two to three orders of magnitude greater than the comparison K_d value for trichloroethylene.

In addition to the TCL/TAL and TCLP analysis conducted on the ash and discussed in section 1.2.5.1, four soil samples from select locations were also subject to the same testing. These samples were obtained from areas which contained elevated levels of Site related constituents although not all analytical fractions were represented in all the samples. Nevertheless, there were no volatile, semi-volatile, herbicide or pesticide organic compounds detected in the leachate from these samples. As a further evaluation of the potential for organic compounds in soils to leach to groundwater, an estimated concentration of organic compounds resulting from leaching was predicted using a USEPA derived equation. An estimated leachate concentration can be predicted based on the concentration of organic compounds identified in Site soils and the solubility of each organic compound in water.

The USEPA equation to predict the concentration of organic compounds in leachate is contained in 50 CFR 48956 (Wednesday, November 27, 1985). Since the upper level 95 percent confidence interval concentrations of organic compounds in on-site soils were less than 1 ppm (see Tables 2-12 and 2-13 of the RA), the applicable predictive equation is:

$$C_w = BO * C^x * S^y$$

where; C_w is the predicted leachate concentration;

BO is a constant equal to 2.14×10^{-5} for material (soil) exhibiting concentrations less than 1 ppm;

C^x is the concentration of the organic compound present in the material (soil) in ppm;

S^y is the organic compounds solubility in water at ambient temperature (18 to 25 degrees celsius)

^{x} and ^{y} are equal to one when the organic compound concentration in the material (soil) is less than 1 ppm.

Based on application of the above equation and using the upper level 95 percent confidence level concentration for the organic compounds identified as chemicals of potential concern in on-site soils, the predicted leachate concentration (C_w) for each chemical is presented in Table 2-1. These results indicate that if no action were taken, the estimated organic compound concentration predicted by the equation is, in most instances, less than one part per trillion (ppt). The exceptions are chloroform, a common laboratory contaminant, and benzoic acid, which yielded predicted leachate

Table 2-1
Summary of Predicted Leacheate Concentrations for Organic Compounds in Soils
C & D Recycling Site

Organics	Upper 95% Confidence Level[1] (ppm)	Solubility[2] (ppm)	Cw[3] (ppm)
Acenaphthene	0.160	3.47	1.2×10^{-5}
Acenaphthylene	0.213	3.93	1.8×10^{-5}
Anthracene	0.242	1.29×10^{0}	6.7×10^{-6}
Benzo(a)anthracene	0.366	1.4×10^{-2}	1.1×10^{-7}
Benzo(a)pyrene	0.302	4.0×10^{-3}	2.6×10^{-8}
Benzo(b)fluoranthene	0.610	1.2×10^{-3}	1.6×10^{-5}
Benzo(g,h,i)perylene	0.216	2.6×10^{-4}	1.2×10^{-9}
Benzo(k)fluoranthene	0.616	5.5×10^{-4}	7.3×10^{-9}
Benzoic acid	0.909	2.9×10^{3}	5.6×10^{-2}
Bis(2-ethylhexyl) phthalate	0.783	4.0×10^{-1}	6.7×10^{-6}
Butyl benzylphthalate	0.052	(4)	(4)
Chloroform	0.009	9.3×10^{3}	1.8×10^{-3}
Chrysene	0.410	6.0×10^{-3}	5.3×10^{-8}
Dibenzo(a,h)anthracene	0.184	5.0×10^{-4}	2.0×10^{-9}
Dibenzofuran	0.083	1.0×10^{1}	1.8×10^{-5}
Di-n-butyl phthalate	0.068	(4)	(4)
Di-n-octyl phthalate	0.358	3.0×10^{0}	2.3×10^{-5}
Fluoranthene	0.445	2.65×10^{-1}	2.5×10^{-6}
Fluorene	0.206	1.69×10^{0}	7.5×10^{-6}
Indeno(1,2,3-cd)pyrene	0.227	6.2×10^{-2}	3.0×10^{-7}
2-methylnaphthalene	0.225	2.46×10^{1}	1×10^{-4}
Naphthalene	0.062	3.0×10^{1}	4.0×10^{-5}
PCB 1248	0.075	5.4×10^{-2}	8.7×10^{-8}
PCB 1260	0.274	8.0×10^{-2}	4.7×10^{-7}
4,4'-DDT	0.135	3.4×10^{-3}	9.8×10^{-9}
4,4'-DDE	0.025	1.2×10^{-1}	6.4×10^{-8}
Phenanthrene	0.341	1.29×10^{0}	9.4×10^{-6}
Pyrene	0.459	1.3×10^{-2}	1.3×10^{-7}

Table 2-1 (continued)
Summary of Predicted Leacheate Concentrations
for Organic Compounds in Soils
C & D Recycling Site

Notes:

1: Concentrations reported on Tables 2-12 and 2-13 of RA.

2: Solubilities at 25^{0}C as indicated in Groundwater Chemicals Desk Reference by J.H. Mongomery and L.M. Welkom, Lewis Publishers, 1990.

3: Predicted leachate concentration from USEPA Equation in 50 CFR 48956 Wednesday, November 27, 1985.

4: Phthalic Acid and associated esters are essentially insoluable in water (Merck Index, Eleventh Edition, 1989).

concentrations of 1.8 ppb and 56 ppb, respectively. Neither of these chemicals are Site related.

Current groundwater data indicates that organic compounds have not leached from soils. This is expected given the relatively high K_d values exhibited by these chemicals in addition to the results of the TCLP test. The USEPA predictive leachate equation further indicates that in the unlikely event these organic compounds were to leach in the future, the resultant leachate concentration for the majority of organic compounds would be significantly below detection even before the leachate was able to disperse into groundwater.

Chemical speciation, adsorption, and fixation reactions exert primary control over inorganic chemicals, particularly metals, in soils (Dragun, 1988). Most metals in environmental media exists in one or more molecular or ionic forms or species. These species can have different valences and, combined with various soil characteristics such as acidity and alkalinity, ion and anion exchange, cation exchange capacity, and adsorption, cause metals to exhibit different mobilities.

Three soil samples were collected from areas within the Site which exhibited elevated levels of inorganic constituents and subjected to TCLP analysis. The results of the TCLP analysis along with the corresponding total metals concentration is provided in Table 2-2. The total concentrations reported for most metals were within or close to the background range. The exceptions were the concentrations of selenium and silver in sample D-500 and the concentration of lead in all samples. The TCLP metal concentrations for all the samples were below the established regulatory level with the exception of lead. While two samples (C-800 and D-500) exhibited TCLP concentrations in excess of the regulatory limits, these samples contained up to 18 percent lead. The TCLP

Table 2-2 Summary of Valid TCLP Results for Metals C & D Recycling Site						
INORGANICS	C-800		D-500		F-600	
	Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)	Total (ppm)	TCLP (ppm)
Arsenic	3.8J	0.0085Q	10.5	ND	2.3J	ND
Barium	NT	0.875J	55.4	0.536J	NT	1.58J
Cadmium	1.2	ND	2.0	0.0113	ND	ND
Chromium	14.0	ND	19.2	ND	5.4J	ND
Lead	7,970.00	69J	188,000J	1,030	393J	0.0586
Mercury	0.12	ND	0.13	ND	0.12	ND
Selenium	ND	ND	ND	ND	ND	ND
Silver	0.89Q	ND	9.10	ND	ND	0.0083Q

Notes:

J = Laboratory data flag implying the compounds or elements are present and the concentrations are relative to the concentrations of other compounds or elements flagged with a J.

Q = Laboratory data flag implying the compound or element is present but precise concentration cannot be measured (qualitative value).

NT = Not Tested

ND = Not Detected

concentration of sample F-600 was two orders of magnitude below the regulatory level of 5 ppm while the total lead concentration in this sample was 393 ppm.

Lead undergoes extensive fixation reactions in soil, thereby inhibiting the leaching of lead to groundwater. Typically, the lead concentration in groundwater remains in the low ppb range as a consequence of lead in soil. Fixation reactions occur when soil transforms or fixes the chemical in an unavailable or unleachable form (Dragun, 1988). The solubility of lead in soil, when the Ph of the soil solution is 8 or greater, is dominated by lead oxides [PbO (yellow and red)] in cases where at least 10^{-3} moles of Pb^{+2} are present. Lead is also capable of forming numerous phosphate minerals in soil. Since the average phosphate concentration in soils is 600 ppm, phosphate typically acts as a major control of lead in solution. The lead phosphate mineral (chloropyromorphite) is the most insoluble complex capable of controlling Pb^{+2} solubility throughout the Ph range of most soils. Where lead phosphate mineral is present, a soil Ph of 3 would be necessary to generate leachate containing lead in solution in excess of 50 ppb even before the leachate solution disperses in groundwater (Dragun, 1988).

In summary, the fixation reactions should dominate lead in soil to such a great extent that an extremely low Ph value would be required to cause leaching to occur at concentrations in excess of the current primary drinking water standard. Lead has not been detected in groundwater samples at concentrations which would suggest any leaching from Site soils has occurred. Furthermore, based on an average Site soil pH of 5.64 (ranging from 4.1 to 7.6), the literature indicates that the potential for lead to leach from soils in the future is negligible.

The existing information indicates that groundwater has not been adversely impacted from organic compounds or inorganic constituents in soils at the Site. Furthermore, leachate testing, predictive leachate concentration calculations and the literature indicate that groundwater is unlikely to be impacted in the future, especially when soil remediation is planned (see section 2.2.2). Therefore, there is no further discussion pertaining to groundwater included in this FS.

2.1 Media of Interest.

As stated above, there are 6 media of interest for which remedial action objectives will be developed. These media are:

1) Ash
2) Soil
3) Pond Sediments
4) Storm Water Sewer System Sediments
5) Site Building
6) Casing/Wire Piles

These media are located in areas, both on-site and off-site, which have been impacted by Site activities. Samples of ash, soil and sediments collected during the RI confirmed elevated levels of Site related constituents in these media. Although sediments in the storm water sewer, Site buildings and remaining cable/wire piles were not specifically sampled during the course of the RI, it is logical to conclude that these media have been impacted to some degree by the Site related constituents. As appropriate, remedial action objectives and general response actions will be considered for these 6 media of interest.

2.1.1 Ash. The ash piles which remain on-site present a potential continuing source of chemicals of potential concern to other environmental media, particularly soil and sediment. The ash piles have covers which are periodically maintained to ensure the ash is not exposed to the elements. A permanent remediation of the ash, which eliminates the need for ash pile maintenance, would be